NATIONALGEOGRAPHIC.COM/MAGAZINE | NOVEMBER 2008

NATIONAL GEOGRAPHIC

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26
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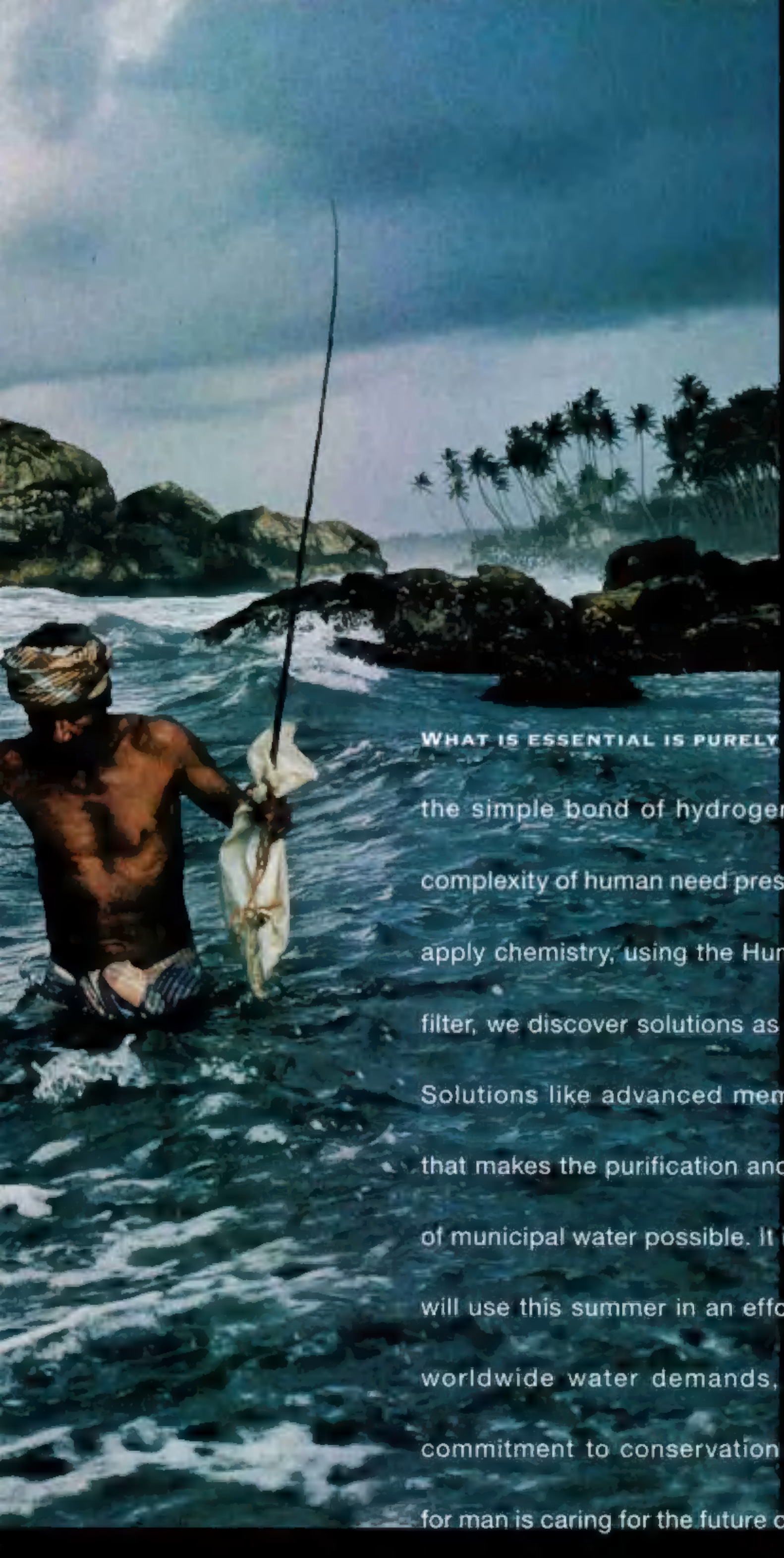

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NATIONAL GEOGRAPHIC

NOVEMBER 2008 · VOL. 214 · NO. 5

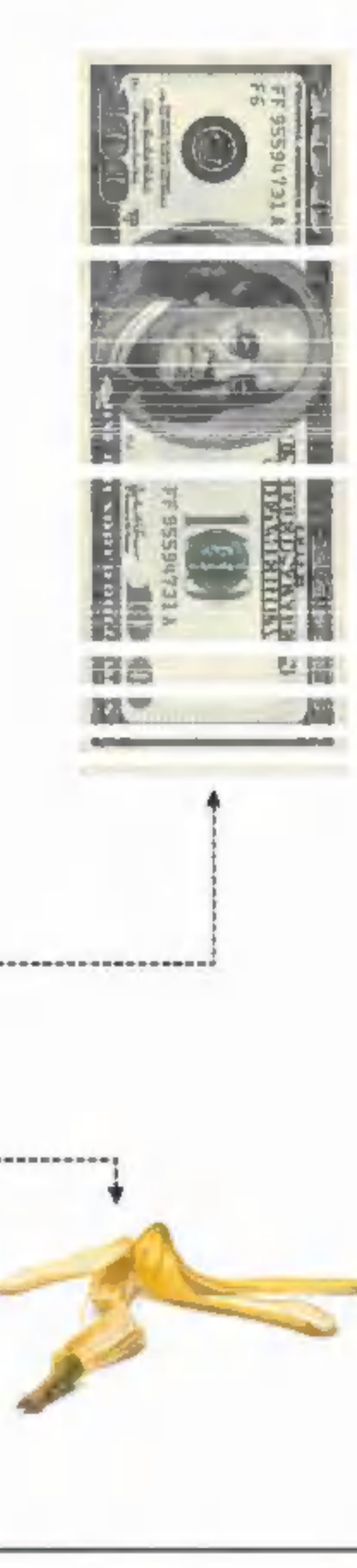
ROBB KENDRICK

Adorned in traditional body paint, a Tarahumara youth poses with a discarded picture frame.

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY

NATIONAL GEOGRAPHIC

NOVEMBER 2008



CULTURE

Electoral Collage

Which countries have high—and low—turnouts?

SCIENCE

Lick Your Poison

A scientist studies frogs with her tongue.

GEOGRAPHY

A World of Millionaires

Meet the newest members of the club.

CONSERVATION

The Last Banana

A fungus is tripping up the supermarket staple.

WILDLIFE

Pandas After the Quake

The Chengdu quake rattled China's bears.

HISTORY

Purple Hearts

The honor has sparked current debate.

On the Cover

Dazzling Chicago nightscape lights up the clouds but obscures the stars.

Photo by Jim Richardson

ngm.com

Sixty Seconds of Fame

A bucking bronco, a charging bull, and a flying skateboarder are some of the stars of My Shot Minute, a weekly video based on favorite reader submissions.

AIZUDDIN SAAD

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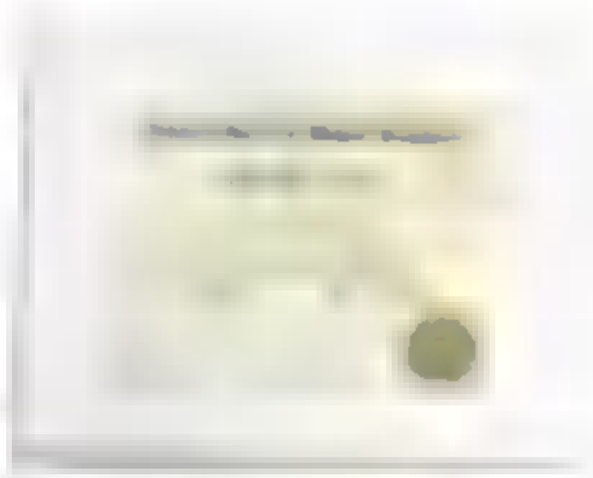

Alexandria, VA

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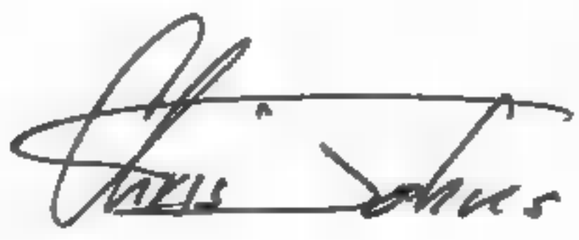
EDITOR'S NOTE

The street sign points to the real thing: the Milky Way, undimmed by outdoor lights in a stretch of southeastern Arizona.

The night sky in the small, rural Virginia community I call home is a big deal, but I didn't realize how big until our local schools considered installing stadium lighting for nighttime sports. The controversy that erupted surprised me. I thought there'd be arguments about the cost of installing and maintaining lights—and there were. I just never expected the most intense debate to revolve around the potential light pollution of our famously dark skies. When the Rappahannock County Board of Supervisors heard public comments on the issue, eight residents spoke in favor of the lights. Nine spoke against. Readers of the local newspaper also weighed in. "Our children will have the opportunity to play more sporting events," wrote one supporter of the proposition. The lights "will fundamentally and unalterably change the quality of life," countered an opponent.

Light pollution is ■ rather new, unintended consequence of technology in the arc of human history, reports Verlyn Klinkenborg in our cover story. The beauty of an ink black night aside, darkness turns out to be as essential to our biological well-being as light. The cyclic rhythm of waking and sleep parallels the cycle of light and dark on Earth. Tampering with it may turn out to have biological repercussions.

Back to the light storm in my own backyard: After an anonymous donor offered financial help, the measure passed, four to one. It was "best for the kids," the superintendent of schools said, but the jury may still be out on that one.



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Drill *(Mandrillus leucophaeus)*
Size: Head and body length, females 45 - 50 cm (17.7 - 19.7 inches), males 61 - 90 cm (24 - 35.4 inches); tail, females 5 - 9.4 cm (2 - 3.7 inches), males 8.6 - 12.5 cm (3.4 - 4.9 inches) **Weight:** females 7.2 - 20.5 kg (15.9 - 45.2 lbs), males 19.8 - 45 kg (43.7 - 99.2 lbs) **Habitat:** Lowland and submontane tropical rainforest. **Surviving number:** Estimated at fewer than 10,000

Photographed by Cyril Ruoso

WILDLIFE AS CANON SEES IT

Grunt, grunt, go! The alpha male gets the other drills moving with two deep grunts. He will generally stay well ahead of the troop, which numbers up to 20 or so and includes related females and offspring. It is the alpha male who bears responsibility for keeping the troop safe and for leading them to food. Spending their days in thick jungle, they forage on the ground and in trees for tidbits such as fruits, nuts, eggs and small animals. But the shrinking size of the drills' rainforest home hangs over their heads; with one of the most restricted ranges of any large African monkey, deforestation and hunting are driving populations to the edge.

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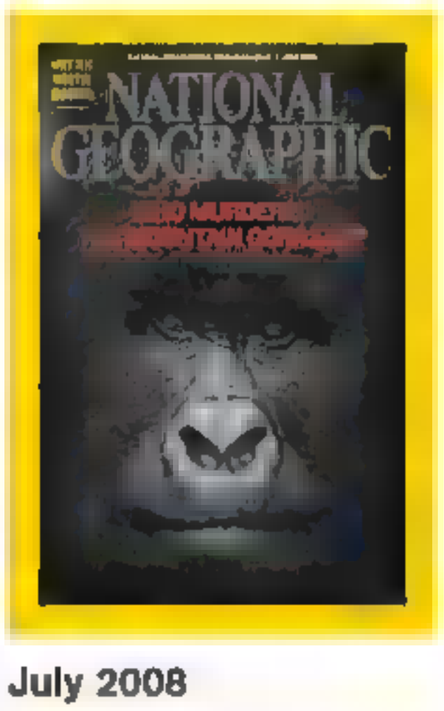
LETTERS



July 2008

Who Murdered the Virunga Gorillas?

To use "murder" to describe the killings of animals is troubling. The word "murder" (the unlawful premeditated killing of one human being by another) is and should be reserved for people. Using the word outside of its definition not only redefines the term but also minimizes its meaning by equating people to animals. Regardless of how you feel toward animals, the murder of millions of people in Darfur and other regions is ■ far greater crime. We are slowly being desensitized to the killing of humans every time animals are elevated to our level.

CHRIS FALZON
Irvine, California

Thank you for correctly calling the tragic, senseless killing of these gorillas murder. Anyone who has ever looked into the eyes of a gorilla or any other great ape knows instinctively that these magnificent creatures are so closely related to human beings that the differences are irrelevant. If gorillas have no soul, then neither do men.

MICHAEL FANTIN
Mount Vernon, Ohio

Isn't it astonishing that the killing of these creatures is disdained as "murder" while the killing of other creatures is considered the "meat industry" or the "fishing industry." I look forward to ■ day when humans will consider all beings our brothers and offer them the respect and care that villagers extended to Senkwekwe and his family. The consciousness displayed by these people in the midst of a seemingly dismal living situation is an inspiration.

VANESSA MASSEY
Lahaina, Hawaii

I was appalled to find that the basic motivation behind the killings was a corrupt $30-million local charcoal industry. For $30 million we're going to allow these creatures to go extinct in the wild? Consider this comparison: Each National Football League team had a salary cap of $109 million last year. With 32 teams, each could drop their cap by one million—less than one percent—and cover this expense. How do we solve this? How do we get resources to these people so they stop cutting down the forest? I feel I have enough to apologize for to my four-year-old without this extinction, which seems like it should be almost trivial to stop.

DOUG BLAIR
Pittsburgh, Pennsylvania

I know the article focused on the plight of the gorillas and Virunga National Park. But I was even more concerned about the plight of the poor, hungry human beings who have to steal wood from the park in order to boil their water and cook their food—and who sometimes have to beg for mercy. The plight of these human beings should be our very first concern.

BRYAN BERRY
Joliet, Illinois

Your picture of a woman in rags wailing desperately for ■ pile of sticks as well as that of two women crying at the boots of a ranger for ■ bag of charcoal says it all. Those two items, which most of us would not lift a finger to obtain, mean everything to them.

HARALD GREPNE
Loddefjord, Norway

The illegal charcoal trade will continue to thrive until people find another way to cook. Much of the African continent is drenched in sunshine for a significant part of the year, but most Africans don't tap into its energy for cooking and pasteurizing water. Solar cookers are a simple technology that can be manufactured locally, creating jobs, reducing pollution, saving millions of acres of forest, and helping to preserve the fragile ecosystem of the mountain gorillas. Solar cookers should be used whenever the sun is shining, and precious combustibles saved for nights and cloudy days.

PATRICIA McARDLE
Board of Directors
Solar Cookers International
Arlington, Virginia

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LETTERS

Under Fire

I was shocked that over three billion dollars a year is spent on fighting wildfires, especially since it now seems experts agree that it's better if fires can be allowed to burn. Will somebody explain to me why that money wouldn't be better spent on creating and maintaining firebreaks to protect areas with human habitation? Elsewhere they could just let the fires burn.

JOHN INGRAM
San Rafael, California

I read "Under Fire" this morning, and by the afternoon a dry lightning storm had ignited hundreds of fires in the extremely dry and overfueled forests of northern California. The smoke is so thick I can see only a few miles now, and the sun is casting an eerie glow upon the land. Who knows what will happen in the next few days? If high winds come, it will be ■ disaster long remembered. The current conditions of our forests make it clear that forest management policies are not working and never will in the long term. Changes need to be made now. Native peoples here before European contact managed the forest and land in a sustainable way for thousands of years. Maybe we should adopt some of their practices before it is too late and the West turns into a desert.

CHARLIE DUNCAN
Whitmore, California

Though not currently closely associated with fire suppression, I have been in the past—spent time digging fire lines, mopping up after fires were controlled, and serving on a helitack. I now contribute to fire suppression by serving as an aerial observer with a pilot in a fixed-wing aircraft. I question Neil Shea's description in the introductory paragraphs that the firefighters were all men, though he did note later in the article that the "U.S. Forest Service firefighter in charge… commands his men and women." In this particular situation, the crew may have been all men, but I find it hard to believe that there were no women on the crew. This could create the impression that there are few opportunities for women in fire suppression. Over the past two or three decades, women firefighters have contributed greatly to both suppressing fires and managing forest and range fuels. These women, along with their male counterparts, deserve recognition for their dedication to a tough job.

The smoke is so thick I can see only a few miles now, and the sun is casting an eerie glow upon the land. Who knows what will happen in the next few days? If high winds come, it will be a disaster long remembered.

SHARON S. BRADLEY
Challis, Idaho

Neil Shea highlights many factors behind the West's wildfire problems, but he left out one important culprit: the wide-scale loss of old-growth forests. While Shea notes that some trees have thick, protective bark that "can survive all but the most severe burns," he fails to connect this idea to the large, centuries-old trees that once dominated western coniferous forests. Old-growth forests are typically more fire resistant because they are less crowded, and the massive trees can have remarkably thick bark. For example, Douglas fir trees can have bark up to a foot thick. Sadly, only a tiny fraction of these old-growth forests remain. Allowing younger forests to mature into old growth is one approach that should be considered to prevent catastrophic wildfires.

MATTHEW FISHER
Bellingham, Washington

I am a lifelong resident of southern California and have witnessed countless fires in the hills and mountains surrounding the San Fernando Valley. Our state is currently in great debt, in a severe state of drought, and millions of people are continuing to pour into these areas. We are forced to spend billions of dollars protecting the homes and property of people who are living in areas that are veritable time bombs due to the greediness of big land developers. Our state government needs to amend the laws to prevent these developers from encroaching farther into wilderness areas. We need these places for the wildlife, not for people who are idiotic enough to risk everything for a view.

DIANE VAN WAGNER
Burbank, California

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LETTERS

Bolivia's New Order

In my native Cuba, Fidel Castro took a very prosperous island and destroyed it. Venezuela's path is quite predictable, and so will be Bolivia's. The little nuggets that author Alma Guillermoprieto dropped perked my ears: agrarian revolution, nationalization of industry, etc. I hope I am wrong, as I do not wish communism even on my worst enemies.

MIGUEL CAMPOS
Mission Viejo, California

It is such a pleasure to see a country like Bolivia finally attempting to settle back into its roots and become more autonomous from the white elite that has basically stolen power over hundreds of years. I remember being so elated when the news of Bolivia's newly elected president broke in 2005, but I was deeply concerned that no one was taking notice of a truly momentous event. Nearly three years later, it is evident that there are still problems to be solved. I feel that Evo Morales can make honest changes if the hearts and souls of the people backing him remain strong.

STEVIE ALVERSON
Maryville, Tennessee

I am an Aymara Indian from the Altiplano of La Paz. Who is in control of Bolivia? Not the indigenous people. Those who are in control use indigenous people. Evo Morales follows orders from Hugo Chávez, president of Venezuela. The idea that white people from the eastern region threaten the stability of the government seems exaggerated. The issue is not racial, it is ideological. This government preaches hate constantly. These people do not like democracy. The situation in Bolivia is very sad. There is more corruption now than before, more poverty than before, more racial hate than before. A lot of people have left the country.

DIEGO CHUYMA
Machacamarca, Bolivia

The Egyptian cosmetic spoon looks remarkably modern. The shape of the girl handle is ■ mirror image of today's Barbie doll. Fantasy prototypes of feminine beauty have an enduring charm.

The Real Jurassic Park

I was intrigued by author Peter Gwin's conclusion that *Guanlong* was a carnivore based on the fossil remains of the larger *Guanlong* that had fallen on top of a smaller one. I came to a different conclusion. In the fossil remains I saw a brave mother attempting to save her trapped child from danger. Unfortunately they both succumbed. Is it not equally plausible that the fossil remains are not capturing a moment of attack, as the author suggests, but rather a moment of love and protection?

MARY-JOAN WALL
Voorhees, New Jersey

Peter Gwin responds: Like detectives investigating a crime scene (granted one 160 million years old), paleontologists were informed by the "criminal histories" of the dinosaurs involved. Suspicion fell on Guanlong *since, based on its teeth and other adaptations, it was ■ meat-eater. Numerous tyrannosaur skulls bear bite marks from other tyrannosaurs (which are descended from* Guanlong*), thus it's possible that this dinosaur engaged in cannibalism. That information, combined with absence of any clues that might indicate gender, makes the "protective mother" hypothesis difficult to justify.*

An Uneasy Eden

I was surprised by the picture of the [Kingman Reef] shark and red snapper sailing by in "deserted" waters with bellies empty (at least the latter). Don't sharks fancy red snapper? I would if I were a shark.

DEIRDRE SMITH
Abu Dhabi, United Arab Emirates

Health: Nile Style

The Egyptian cosmetic spoon looks remarkably modern. The shape of the girl handle is ■ mirror image of today's Barbie doll. Fantasy prototypes of feminine beauty have an enduring charm.

PATRICK DELAVAN
Lansing, Kansas

History: Subway Starts

I was interested in your feature on the history of the London Underground and subsequent developments around the world. You may not realize that the Glasgow subway celebrated its centenary in 1996 and lays claim to being much older than many you mention.

RONALD N. C. DOUGLAS
Glasgow, Scotland

AMERICAN WONDER

FREEDOM IN FOCUS

AS one of the most photographed women in the world, Lady Liberty continues to captivate. "You hear about the statue all your life, but until you go and see her you really don't appreciate her," says National Geographic photographer **Joel Sartore,** who recently went on assignment to shoot the iconic figure. Sartore, using Nikon's brand-new 12.3 megapixel D90™, captured his images by way of boat in order to get a full 360-degree perspective.

To learn about a subject, Sartore encourages photographers to walk around an object (if possible) and try high and low angles to see which perspective is best. "I ask myself if there's anything that can be done that hasn't been done before. I shot the statue from behind to show her facing the planes and helicopters flying around, which was interesting." You can view Sartore's photographs in an interactive 360-degree panorama at *nationalgeographic.com/nikon/statueofliberty.*

Sartore finds the statue a remarkable subject. "As an American citizen you love what it stands for, but when you're there it's just so enormous—and when you think about the amount of work that went into creating it over 100 years ago, how sheets of copper were beat into wooden molds—it's truly amazing."

SEE JOEL'S WORK AND MORE "AMERICAN WONDERS" **in 360 degrees,** YOU CAN EVEN **add your own photos** TO THE MIX, AT:

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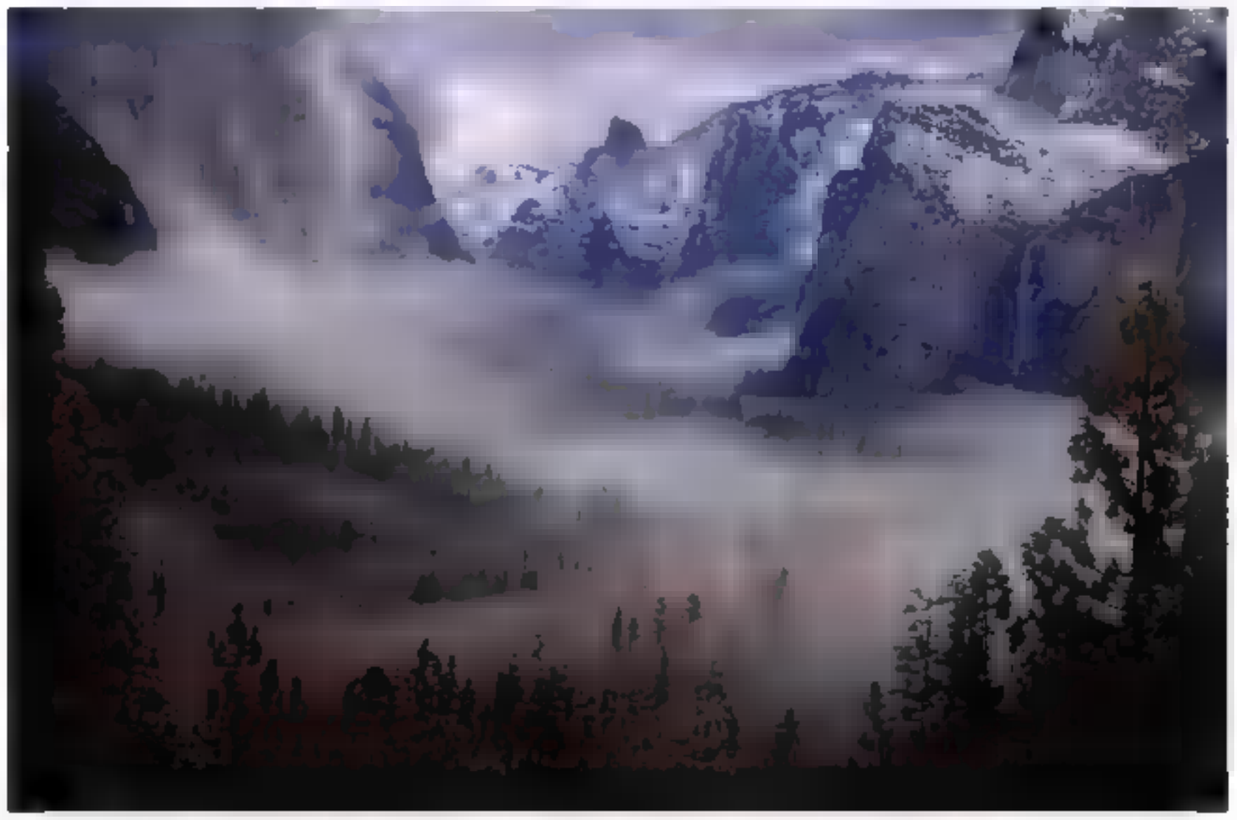
Bonnie Marsh Chanhassen, Minnesota

A gecko guest joined Bonnie Marsh for dessert during her Hawaiian vacation. It scampered down from the restaurant wall, licked the plate, then ran off. Marsh, 66, got into digital photography three years ago—but has taken pictures since first picking up a Brownie at age 12.

Phil Hawkins Fresno, California

Professional photographer Phil Hawkins, 55, shot this misty Yosemite scene just after dusk. This photograph was voted an *ngm.com* audience favorite.



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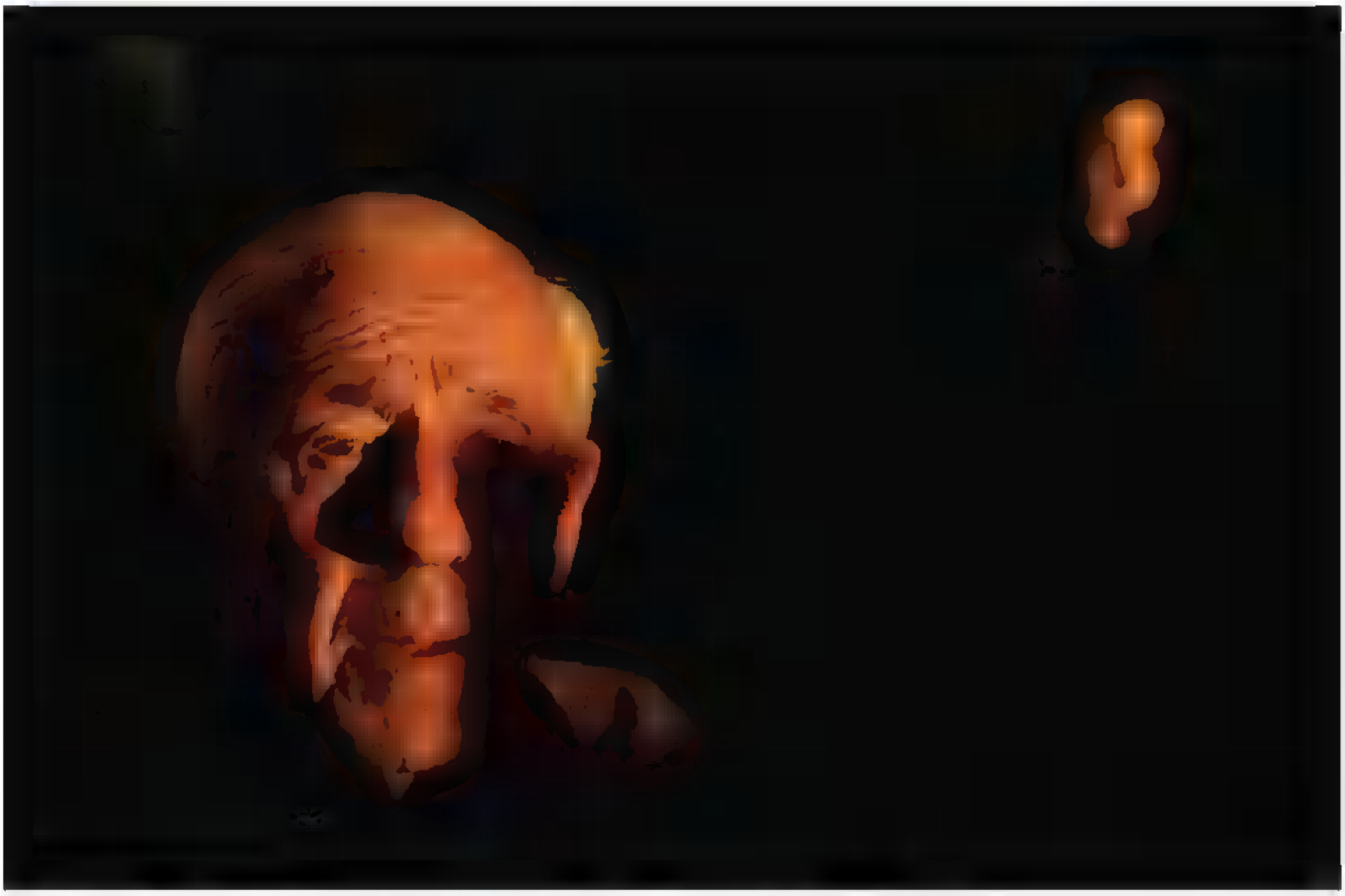

In his last years, Herbie Winokur depended on his daughter and her family for care.

Ed Kashi is a longtime National Geographic photographer. For more of his and Julie Winokur's work on the "sandwich generation" visit talkingeyesmedia.org.

Living With Herbie My wife, Julie Winokur, and I moved from California to New Jersey in 2006 to be close to Julie's father, Herbie. We were determined to be there for him, as he'd always been there for his kids. When dementia made it impossible for him to live alone, he moved in with us and our children, Eli and Isabel.

With an eight-year-old's simplicity, Isabel summed up the transformation: "When Poppy moved in, a bunch of things changed in the house." Julie and I joined the "sandwich generation," an estimated 15 million Americans who look after elderly parents and parents-in-law at the same time they're raising their own children. As photographer and writer-filmmaker, we'd documented aging issues. We were confident that we could handle Herbie's needs, be good parents, and manage our careers. Eighteen months later, we were more humble, less certain. Julie feared the kids were beginning to "feel like the day Poppy moved in is when they lost Mommy and Daddy." Sometimes I just couldn't appreciate the joys filling our house that my father-in-law was a part of.

On Saturday, January 5, 2008, Herbie passed away at home, with Julie at his side. We're a nuclear family again. But Herbie's legacy is still with us: He helped us learn to be more gentle with each other, and more honest. And he connected our family to millions of other families whose members are committed to coming through for each other—parents and grandparents and children together—in whatever traditional or creative ways they can manage.

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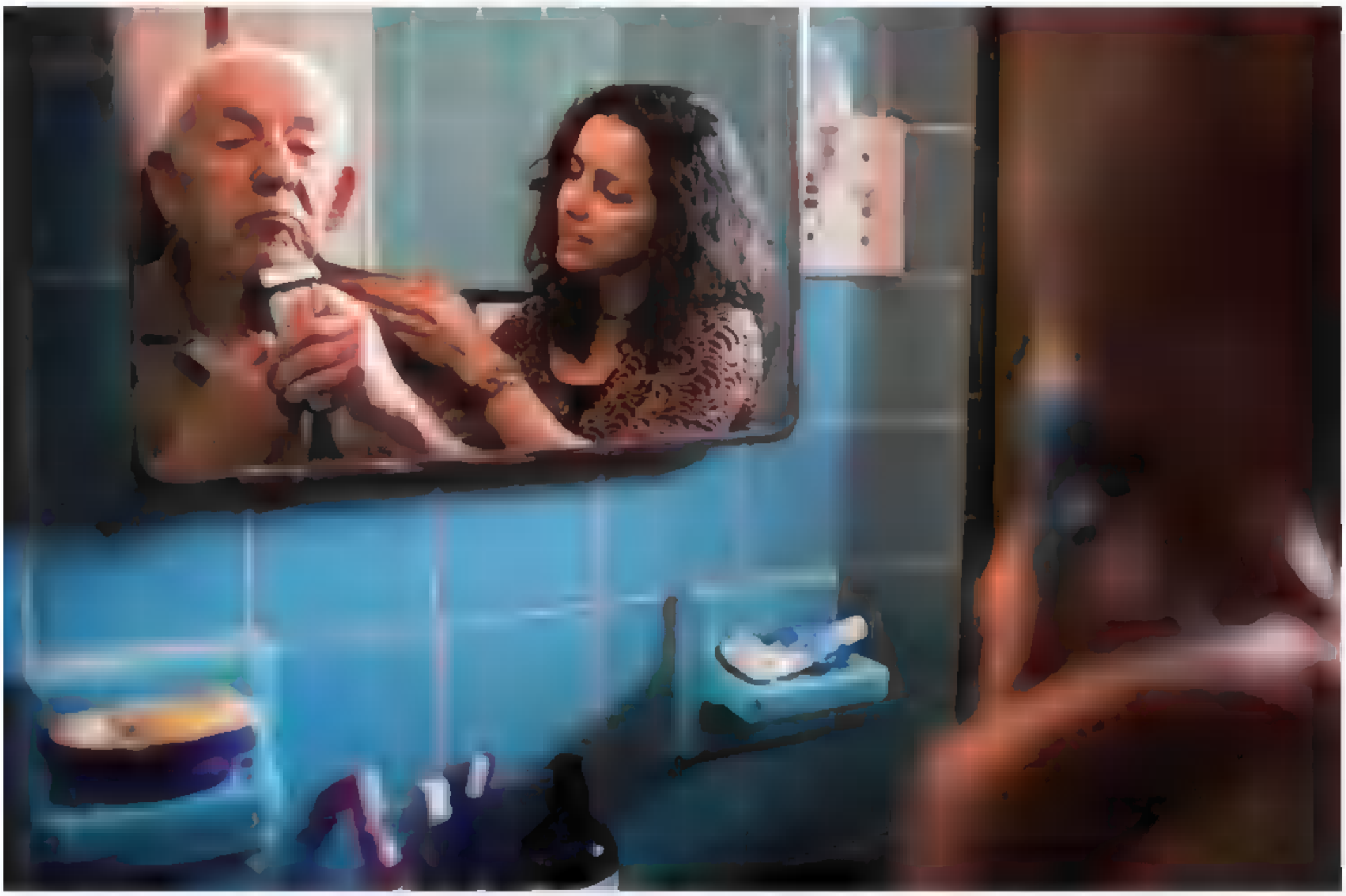
PHOTO JOURNAL | ED KASHI



Herbie's illness changed simple private rituals, like shaving, into shared efforts. Some days the eightysomething New Jersey native was his familiar self—funny and warm, a dapper widower who'd served in World War II and been ■ successful lawyer. On other days Julie felt the father she had always known and loved was already gone.

Disabled by dementia and ■ Parkinson's-type movement disorder, Herbie needed nearly constant assistance—to dress, bathe, eat, rise from a chair, take his medications at the right times. Between her parent and her children, Julie said, "there was not a minute of the day that somebody didn't need something from me."

He couldn't paint or play an instrument.

Something in wine brought out everything Robert Mondavi had to offer the world. It could absorb all his passion. Express all his vision. And never make him wish he was creating anything else. Passion is not often something you can taste. Yet that's precisely how his wines can be recognized.

ROBERT MONDAVI

Eight-year-old Isabel came along when her mother took Herbie to visit old friends at the Seaview Market on Fire Island, New York, where Herbie had owned a beach house. "I'm always struggling with the feeling that I don't have enough time and attention to pour on the children," Julie said.

Warmed by sunshine and ■ blanket his daughter made for her own children, Herbie shared prime nap territory with Luana the cat. "Every single day I watched him slipping away a little more," Julie said. Nearly ten million Americans struggle to look after family and friends robbed of independence and memory by dementia.

African Penguins mate for life. Watching them from atop the ancient boulder, as they frolicked under the hot African sun, I felt a bond that would stay with me forever.

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SOUTH AFRICA

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PHOTO JOURNAL | ED KASHI

In a home filled with tools for play and creativity, Herbie could rarely do more than watch from the sidelines—or the back door. Always "extremely kind," Herbie remained gentle even as his condition worsened, Kashi said. But Ed worried that Eli and Isabel would grow up fearing the future, "thinking that this is what getting old has to be like."

As Herbie fell asleep at the end of a particularly difficult day, Julie and Ed found comfort in a weary embrace. "You have to look at caregiving as a marathon," Julie said, "not a sprint." The experience challenged every member of the family, but Herbie gave them all "a life lesson," Ed said, "in what it means to care for someone."

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Das Auto.

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Chile The fury of Chaitén volcano seems to set the sky on fire. Highly charged particles of pumice roar upward in spreading clouds of gas and smoke, generating crackling tangles of lightning.

PHOTO: CARLOS GUTIERREZ UP/DIGITAL RAILROAD

Solomon Islands Like a pale brooch atop royal velvet, a brittle star—barely as big as a nickel—crawls across the arm of an 18-inch-wide blue sea star. The smaller creature took just seconds to traverse the larger.

PHOTO: BIRGITTE WILMS, MINDEN PICTURES/NATIONAL GEOGRAPHIC STOCK

India Children of the many snake charmers in the village of Padmakesharpur are no strangers to cobras. Early encounters with defanged or devenomed snakes help the babies grow up fearless.

See more Visions of Earth images at **visionsofearth.ngm.com.**

PHOTO · ADRIAN FISK, DIGITAL RAILROAD

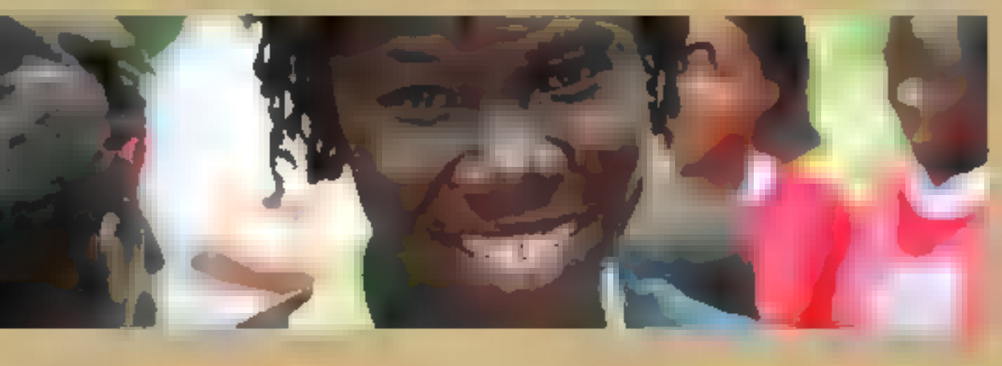
Sol and Thome explore stories of leaders who brought an Amazon people back from the brink of extinction, share ancient knowledge in the mountains of Peru, and provide health care to thousands in Haiti.

NATIONAL GEOGRAPHIC EMERGING EXPLORERS SOL GUY and JOSH THOME use their 4REAL TV series and Website to focus attention on community activists creating positive social change around the world. But telling these stories is just the beginning. The real goal is to tap the interactive power of technology and inspire their audience to become directly involved in meaningful ways of their own.

Photos: Josh Thome (top) and Sol Guy

"Telling stories hasn't changed in a million years, but today we can tell them in a whole new space. Technology can be leveraged in such cool interactive ways. People see our segments about amazing community leaders and want to respond. We start the story, but the Web lets our audience get involved and take it in totally new directions. They don't just watch it, they co-create it. One kid found a way to send medical supplies to Kenya. A music celebrity helped build a school in Liberia. Others donated to health care in Haiti and organized music festivals to raise funds. People even say they changed professions because of what they saw on 4REAL. The Internet and media have created this new global culture. We use it to give constant feedback so everyone has a stake in what happens and sees real results. We'll show a leader making a huge difference, but then our audience takes it and runs with it—that's always been our dream and now it's 4REAL."

- Sol Guy and Josh Thome -



To learn more, visit *4REAL.com*.

Visit *nationalgeographic.com/emerging* to see and hear the Emerging Explorers.

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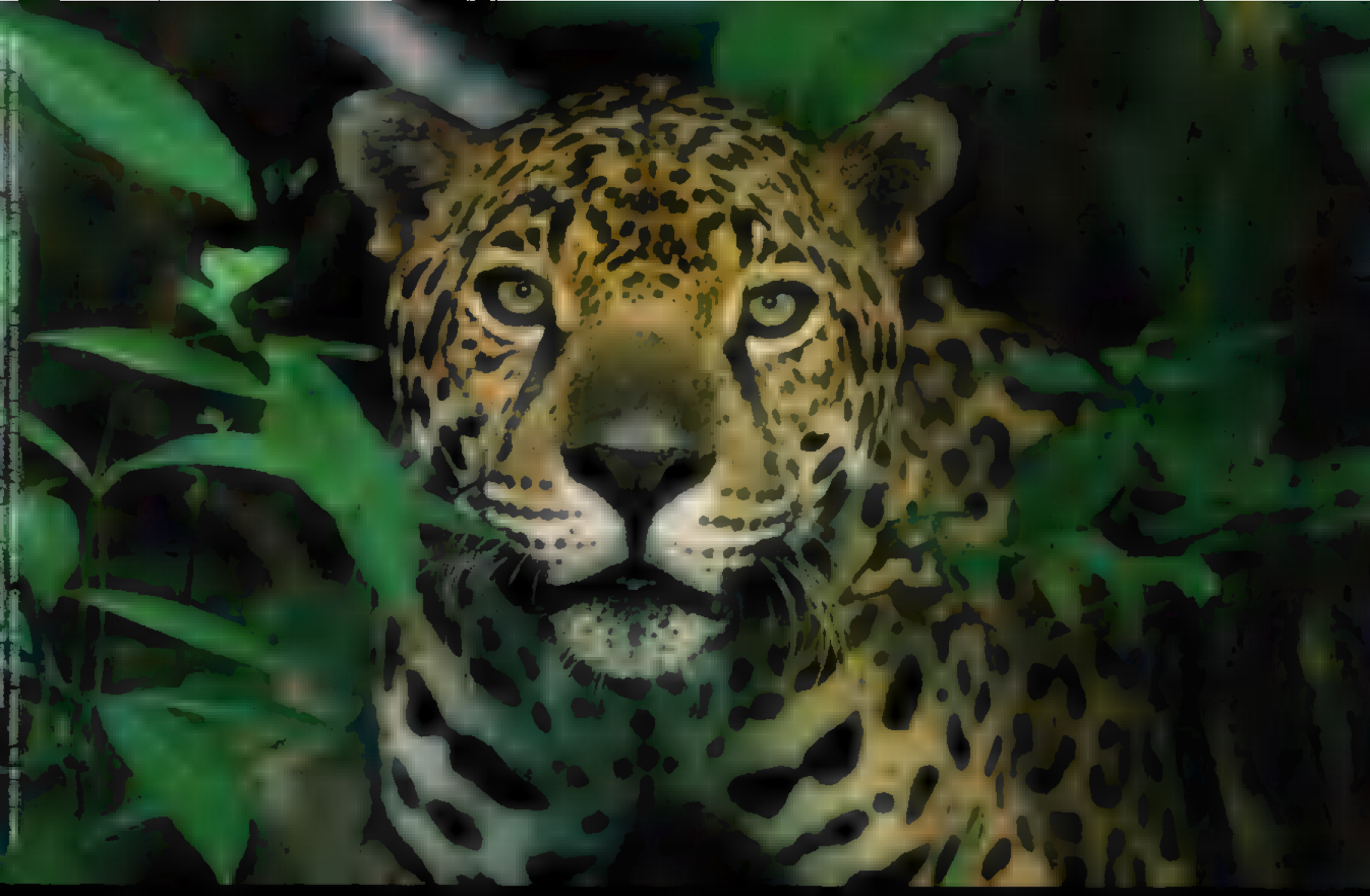

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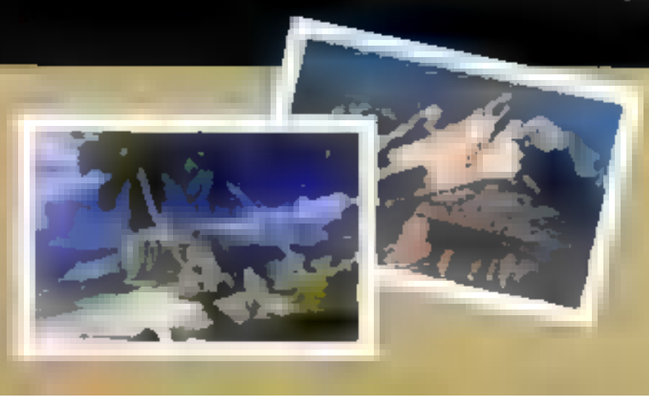

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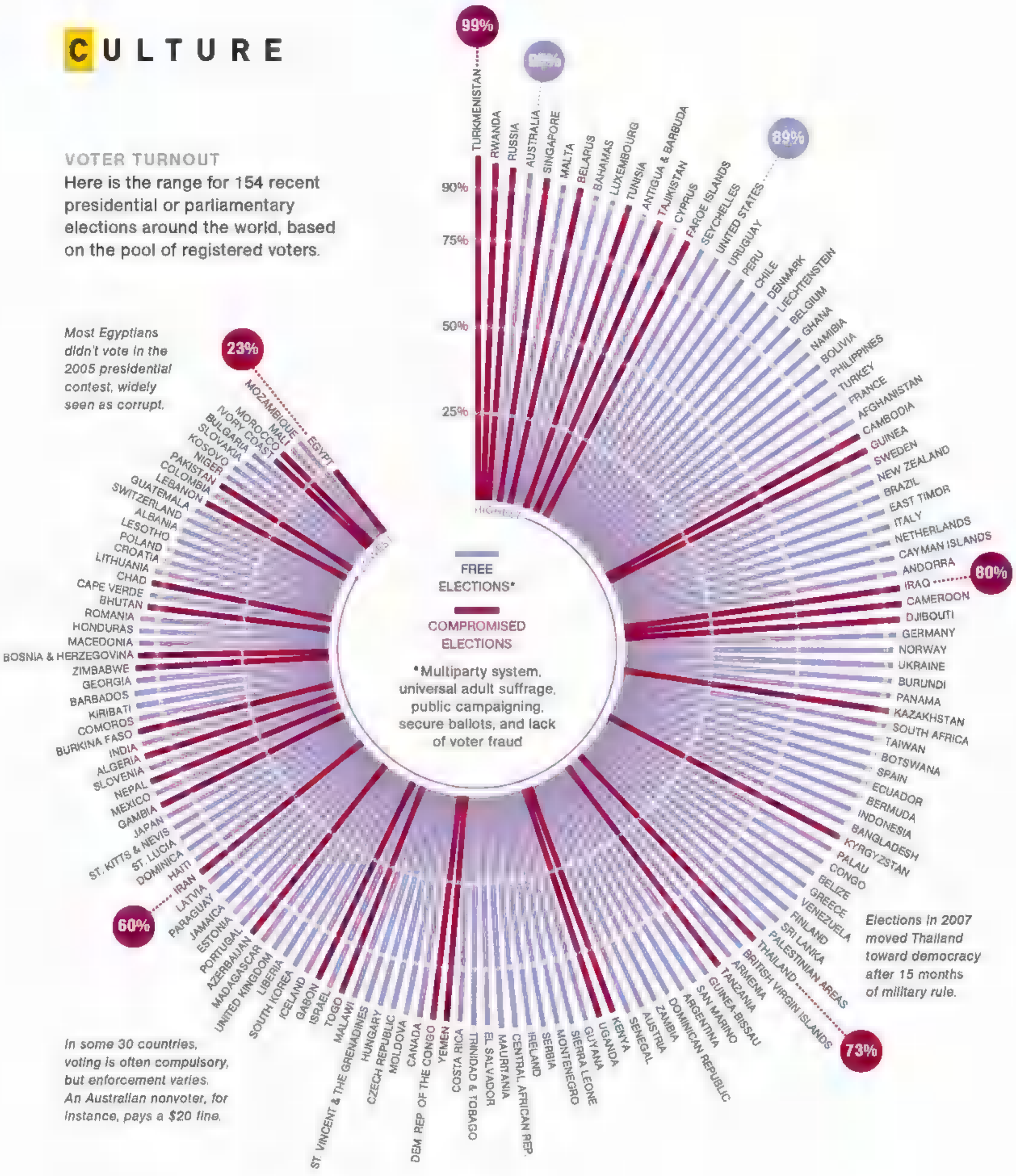
CULTURE

VOTER TURNOUT

Here is the range for 154 recent presidential or parliamentary elections around the world, based on the pool of registered voters.



Electoral Collage Voter turnout turns out to be a tricky topic. Turkmenistan and Rwanda are the leaders, but recent elections have been widely criticized. Australians must go to the polls or face a fine; they sometimes respond by casting blank ballots. And even though the 2004 U.S. presidential race had the best turnout since 1968, Americans are often seen as apathetic. For years U.S. turnout seemed to be plummeting toward the 50 percent mark, says political scientist Michael McDonald. The reason is that the entire voting age population was surveyed; booming immigration after 1970 created a big population that could not vote. Turnout of eligible U.S. voters has been fairly steady—and could be the greatest in a century this month. When interest is high, notes Rafael López-Pintor of the International Foundation for Electoral Systems, turnout soars. *—Shelley Sperry*

GRAPHIC: SEAN MCNAUGHTON, NG STAFF. SOURCES: INTERNATIONAL FOUNDATION FOR ELECTORAL SYSTEMS; FREEDOM HOUSE; INTERNATIONAL INSTITUTE FOR DEMOCRACY AND ELECTORAL ASSISTANCE

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moving forward

SCIENCE

NG GRANT **Lick Your Poison** Valerie C. Clark's field methods may seem weird. When she sees a frog, she catches it. Then sniffs it. Then licks it. All of which helps her get to know her subject quickly. "Maybe one day I'll find my prince," she jokes.

Clark, a chemical biologist, studies amphibian secretions and toxicity, focusing recently on frogs from Madagascar that ooze alkaloids from their skin glands. The frogs, she says, don't make the alkaloids themselves; they get them by consuming prey that contain these chemicals. But they do depend on the bitter compounds for survival: The poison in alkaloids is what makes the frogs unpalatable to predators.

In Madagascar, Clark found that the more pristine the region, the more toxic the frog—probably because a wider variety of alkaloid-rich ants, millipedes, and mites is available in undisturbed areas than in disturbed ones. It also suggests frogs living in more biodiverse spots have a greater chance of survival than their less geographically fortunate cousins, which may have to learn new defense tricks as they become less toxic—and more appetizing.

"It comes down to taste," Clark says. "If you don't taste bad, somebody's gonna eat you." *—Neil Shea*

Valerie Clark sniffs for toxins before she licks; a poison dart frog in the wild would be too potent for a taste test. This captive-bred specimen eats different foods, which makes it safe to sample.

PHOTO: REBECCA HALE, NG STAFF

i'm unavailable. out of pocket. not at my desk. not in the office. can't be reached. no texts. no voice mail. no buzzing. period. yesss. this is my time. my eight hours. my space. my way. finally. i can get some work done. or i could nap. and then work. definitely nap first.

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NORTH AMERICA 3,300,000 millionaires

— United States **3,028,000**
— Canada

EUROPE 3,100,000

— Germany **826,000**
— United Kingdom
— France
— Italy
— Switzerland
— Spain
— Russia **136,000**
— Netherlands
— Norway
— Sweden
— Denmark
— Other

ASIA 2,606,000

— Japan **1,510,000**
— China* **581,000**
— India **123,000**
— South Korea
— Singapore
— Other

MIDDLE EAST 400,000

— Saudi Arabia
— United Arab Emirates
— Other

LATIN AMERICA 400,000

— Brazil **143,000**
— Other

OCEANIA 194,000

— Australia
— New Zealand

AFRICA 100,000

— South Africa
— Other

*CHINA FIGURES INCLUDE HONG KONG (95,000) AND TAIWAN (71,000)

Millionaires' Club

The ranks of millionaires, now more than ten million strong, are swelling one BRIC at a time. That's because Brazil, Russia, India, and China—the emerging economies known as the BRICs—are enjoying some of the highest rates of growth in millionaires. According to an annual report on world wealth, the population of those with a million U.S. dollars in assets, not including home value, rose most last year in stock-strong India (up 23%), manufacturing giant China (20%), and ethanol-exporting Brazil (19%), with gas- and oil-rich Russia (14%) surging too. They're joining the usual suspects: the U.S. (the most millionaires total), Switzerland (most per capita), North America (per continent).

But whether you're from a BRIC or an Old Money nation, a million bucks isn't what it used to be. Thanks to global inflation, it's now worth a mere $455,000 in 1983 dollars.

So has being a millionaire lost its cachet? That's rich. "The word is fixed in the popular imagination," says sociologist Leonard Beeghley. "It's still what people aspire to. Perception hasn't caught up with economic reality." *—Jeremy Berlin*

SHOW ME THE MONEY

In 2007 the world's 10.1 million millionaires were worth $40.7 trillion. These are the nations with the most millionaires per capita:

1 **Switzerland** (2.7% of population)
2 **United Arab Emirates** (1.8%)
3 **Singapore** (1.7%)
4 **Norway** (1.3%)
5 **Japan** (1.2%)
6 **U.S. and Germany** (1%)

GRAPHIC: OLIVER UBERTI, NG STAFF; ZACH FERRIOLA-BRUCKENSTEIN
SOURCE: CAPGEMINI/MERRILL LYNCH, *WORLD WEALTH REPORT*, 2008

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Slipping Away The world's favorite fruit is in a whole bunch of trouble: The common banana, an Asian variety called the Cavendish, is succumbing to Panama disease, a malady for which there's no cure. The fungus it stems from causes leaves to wilt and drop off, exposing the rest of the plant to lethal amounts of sunlight. This isn't the first time Panama disease has ravaged a ubiquitous banana: In the 1960s it claimed the Gros Michel ("Big Mike"). Since then, the Cavendish, smaller yet seemingly immune, has made for a worthy stand-in. But now a vicious new strain of the fungus, first reported in Malaysia in the 1990s, is wiping out the world's Cavendish plants. All are genetically identical, so what kills one will kill them all. Banana expert Dan Koeppel—a National Geographic Society grantee—says the best hope for the fruit lies in diversity. To that end, researchers are experimenting with hundreds of feral varieties, trying to engineer a disease-resistant banana that's tasty, robust—and has lasting appeal. *—Catherine L. Barker*

PHOTO: JEANNE MODDERMAN

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In all my years as a GIA graduate jeweler, I have never seen a magnificently large ruby at such an outstanding price. The Oval Ruby Collection is without a doubt one of the best jewelry offerings I've seen in years.
— James T. Fent,
Gemologist

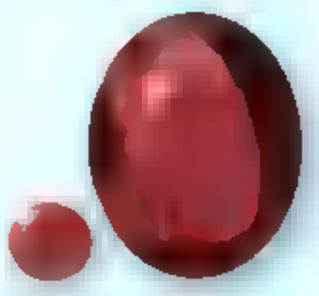
Huge Ruby Found on Bali—Is It Yours?

Paradise is reflected in this magnificent 22½ carat ruby...but the price is the most heavenly.

On the tropical island of Bali, the air is filled with ancient mystery and perpetual festivity. Who would have thought that our deep sea diving trip to this romantic paradise would lead us to a treasure of giant deep red rubies. This beautiful isle is so vivid and untouched it has become the spiritual inspiration for many an artist. Bali has gardens tripping down hillsides like giant steps, volcanoes soaring up through the clouds, long white sandy beaches, and friendly artisans who have a long history of masterful jewelry designs.

We stumbled upon a cache of giant natural rubies at a local artisan's workshop. He brought these exotic Burmese Rubies to Bali and now we have brought them home to you. Our necklace showcases a genuine **22½ carat** facet cut ruby set in a frame of .925 sterling silver in the Balinese style. *That's right—22½ carats!*

The ruby, raised above the hand-crafted Balinese silver detailing is surrounded by a bezel of sterling silver and then wrapped with a twisted rope. The Oval Ruby Pendant measures approximately 1¼" by 1½." This exotic pendant suspends from an 18" silver snake chain and secures with a spring ring clasp. Drape this pendant around your neck for a bold luxurious look. And, since rubies are rarer than diamonds, we hope your rings don't get jealous. Most likely, this will be the largest precious gemstone that you will ever own.



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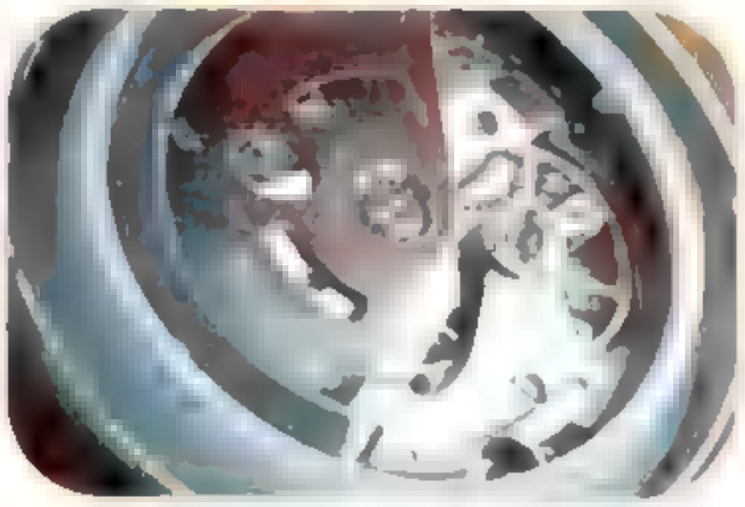
NATIONAL GEOGRAPHIC CHANNEL

Time travel at the speed of a 1935 Speedster?

The 1930s brought unprecedented innovation in machine-age technology and materials. Industrial designers from the auto industry translated the principals of aerodynamics and streamlining into everyday objects like radios and toasters. It was also a decade when an unequaled variety of watch cases and movements came into being. In lieu of hands to tell time, one such complication, called a jumping mechanism, utilized numerals on a disc viewed through a window. With its striking resemblance to the dashboard gauges and radio dials of the decade, the jump hour watch was indeed "in tune" with the times!

The Stauer *1930s Dashtronic* deftly blends the modern functionality of a 21-jewel automatic movement and 3-ATM water resistance with the distinctive, retro look of a jumping display (not an actual jumping complication). The stainless steel 1 1/2" case is complemented with a black alligator-embossed leather band. The band is 9 1/2" long and will fit a 7–8 1/2" diameter wrist.



True to Machine Art esthetics, the sleek brushed stainless steel case is clear on the back, allowing a peek at the inner workings.

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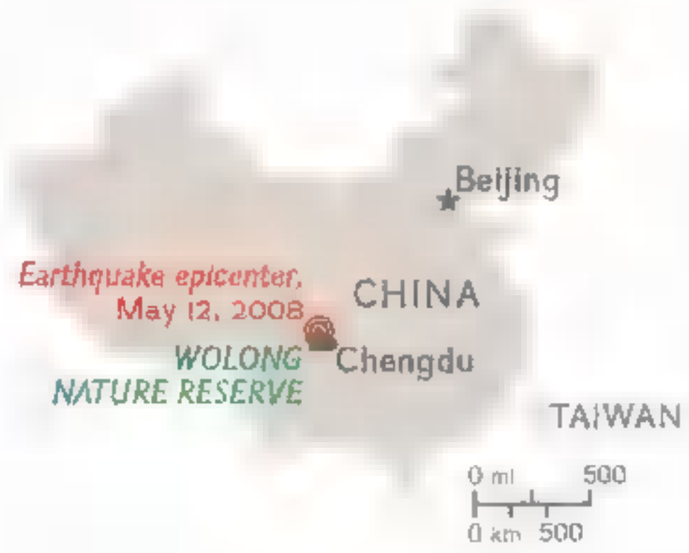
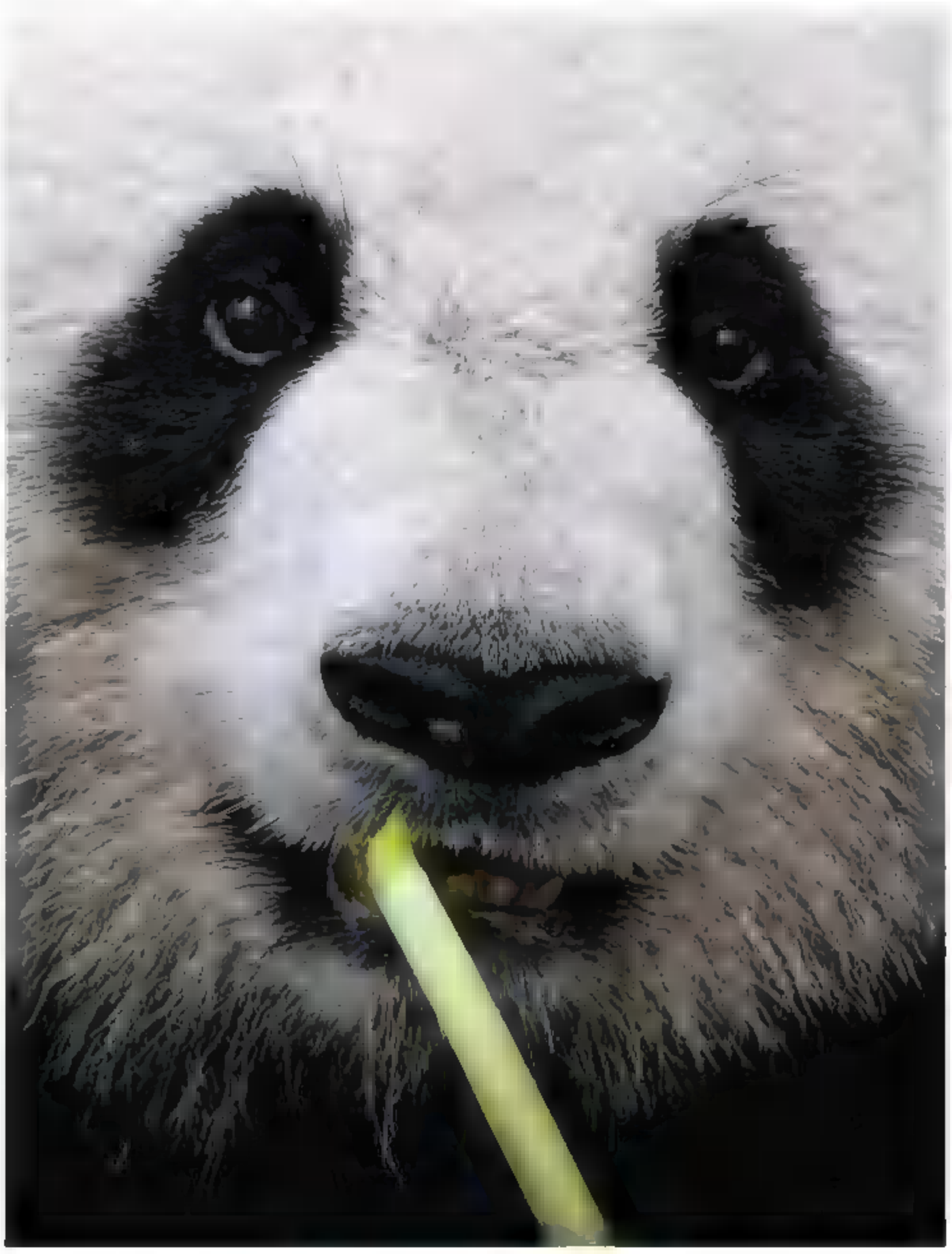


For Pandas, a Troubling Tremor

The earthquake in May that rocked central China killed roughly 70,000 people. It also jolted the lives of the 63 captive pandas housed at the Wolong Nature Reserve, nestled in the mountains less than 20 miles from the quake's epicenter. One Wolong panda—a nine-year-old female and mother of five named Mao Mao—was killed when a torrent of boulders and debris crushed her concrete enclosure. Parts of Wolong's breeding center, and much of the surrounding area, were also badly damaged, forcing workers to evacuate the surviving pandas to other research facilities or the Beijing Zoo. Initially, some of the animals were shell-shocked, climbing into trees and staying there. "Their nervousness has disappeared," says Jianguo Liu, a panda specialist at Michigan State University. Assessing the post-quake condition of China's 1,600 wild pandas remains a work in progress, according to Liu. "But pandas have been around for several million years," he says. "They've experienced earthquakes before." *—Alan Mairson*



SHAKEN BY A DISASTER
In the region struck by the earthquake, all but one of 63 captive pandas survived. Above: a bear that made it. Below: recovering remains of the only victim, Mao Mao, in June.

PHOTOS: JULIE NG (TOP); KATHERINE FENG, NGM MAPS

Saab XWD lets you get the most out of your adventures:

FOOD: It's worth the wait at (no reservations) Joe's Stone Crab, a Miami Beach institution since 1913. The crab claws with mustard sauce are legendary, as is the house's Key lime pie. *11 Washington Avenue; www.joesstonecrab.com*

MUSIC: Presenting a mix of live Latin and American jazz, funk, reggae, and rock, Jazid is open every night. Dance on the main floor or unwind upstairs, where DJs spin soulful sounds. *1342 Washington Avenue; www.jazid.net*

LAUGHS: Stand-up is alive and swell at Coconut Grove's Improv Comedy Club, where you may see talents from HBO's Def Comedy Jam and other TV and cable laugh fests perform. *3390 Mary Street; www.miamiimprov.com*

DON'T MISS: South Beach's Art Deco District preserves the world's largest collection of hotels built in this distinctive style. Walking, bike, self-guided, and cell-phone tours illuminate the era and the architecture. *Ocean Drive; www.mdpl.org*

MUSEUM: The Museum of Contemporary Art, which shows work by local and internationally known artists, is known for innovative, provocative exhibitions. The structure that houses it, by Charles Gwathmey, echoes the aesthetic. *770 NE 125th Street; www.mocanomi.org*

SIDE TRIP: It's about three-hours' drive to Key West via the Overseas Highway, an engineering marvel. Bordered by the Atlantic on one side and the Gulf of Mexico on the other, the scenic roadway leads to Florida's hedonistic haven at Mile marker 0. *U.S. 1; www.fla-keys.com*

LANDMARK: An Italian Renaissance-style villa built in 1916, Vizcaya is a National Historic Landmark. The property, which includes formal gardens overlooking Biscayne Bay and an exhibition space, is open to the public year-round. *3251 South Miami Avenue; www.vizcayamuseum.com*

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Saab XWD lets you get the most out of your adventures:

FOOD: Nothing's precooked, prepackaged, or frozen at LA's iconic In-N-Out Burger, as popular with celebrities as it is with folks who appreciate a juicy burger and a creamy shake. *The original location is at 13850 Francisquito Avenue, Baldwin Park; www.in-n-out.com*

MUSIC: Frank Gehry's metal-sheathed Walt Disney Concert Hall, home to the L.A. Philharmonic, is an acoustic as well as an architectural wonder. *111 South Grand Avenue; www.laphil.com*

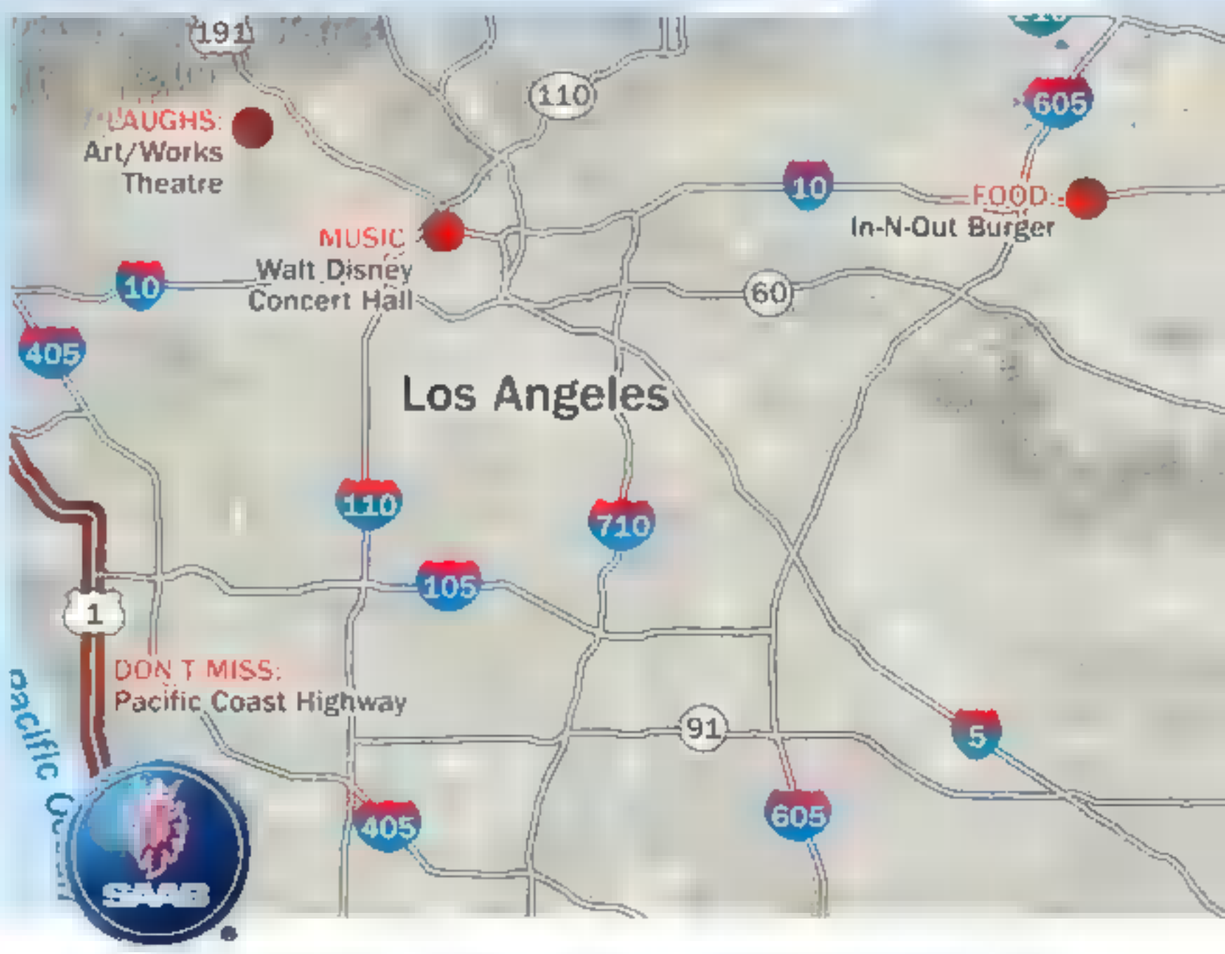
LAUGHS: Yuk it up with today's top comics at the Los Angeles Comedy Festival, which features stand-up, improv, and sketch comedy at the Art/Works Theatre, November 6 through 23. *6569 Santa Monica Boulevard; www.lacomedyfest.com*

DON'T MISS: Stretching nearly the length of California, the Pacific Coast Highway offers magnificent coastal views from San Juan Capistrano, 50 miles south of L.A., to Leggett, near the Oregon border. *Highway 1; www.us-101.com*

MUSEUM: Home to more than a billion dollars' worth of art from Monet to Man Ray, the stunning Getty Center also maintains an art-supply-stocked sketching gallery for inspired visitors. Its Central Garden, a work of art itself, arouses the senses with sights, sounds, and scents. *1200 Getty Center Drive; www.getty.edu*

SIDE TRIP: Palm Springs, where Hollywood types head to unwind, is a desert oasis one hundred miles away that boasts canyons and casinos, galleries and golf courses, shopping and spas. *I-10 East; www.palmsprings.com*

LANDMARK: Everyone from Frank Sinatra to The Beach Boys recorded inside the circular Capitol Records Tower, which remains a beacon to music lovers at the crossroads of Hollywood. *1750 Vine Street; www.hollywoodandvine.com*



For additional cities, Cross Drive activities in Los Angeles, and to submit YOUR OWN experience log onto:
WWW.NATIONALGEOGRAPHIC.COM/SAAB

Trip Notes:

Trip Notes:

Submit your experience and Trip Notes on:
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Let your Los Angeles adventures take flight...
On Hollywood and Vine, the Pacific Coast Highway, and the manicured streets of Palm Springs, the Saab 9-3 XWD crosses California with ease. Saab XWD ® one of the most advanced all-wheel drive systems ever built. By using advanced electronic controls to intelligently sense wheel speed, steering angle, and lateral acceleration, it actively distributes the torque to match driving conditions. That means power is there when and where you need it most, for amazing stability and great handling in all-weather driving. What you feel is better grip, faster acceleration, increased stability, and agile cornering.

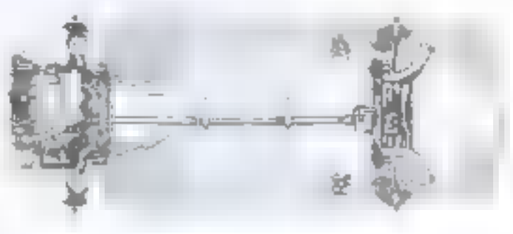
Born From Jets™

XWD

Submit your experience and Trip Notes on:
WWW.NATIONALGEOGRAPHIC.COM/SAAB

Let your Miami adventures take flight...
Whether in the Art Deco District, Coconut Grove's busy streets, or on the Overseas Highway to the Keys, the Saab 9-3 XWD handles them all with ease. Saab XWD is one of the most advanced all-wheel drive systems ever built. By using advanced electronic controls to intelligently sense wheel speed, steering angle, and lateral acceleration, it actively distributes the torque to match driving conditions. That means power is there when and where you need it most, for amazing stability and great handling in all-weather driving. What you feel is better grip, faster acceleration, increased stability, and agile cornering.

Born From Jets™



XWD

A car that reads the road.
What a novel idea.

Most all-wheel drive systems are designed to react to road conditions. Saab Cross-Wheel Drive (XWD) is engineered to anticipate them. With twenty different sensors reading the road 100 times per second, it preemptively transfers power and redistributes torque to keep you a step ahead of the elements. It's one of the most advanced all-wheel drive systems ever built. From dramatic turns and twisting plots to things you never saw coming – you'll be hanging on every word. Saab XWD available in the 9-3 Sport Sedan.

saabusa.com

Born From Jets™

A Madagascan artisan carves a tomb statue.

Sweet Sixty A child born in Madagascar is likely to live 62 years, the longest life expectancy in sub-Saharan Africa. One of the biggest determining factors? The island nation has been largely untouched by HIV/AIDS, says Victoria Velkoff, co-author of ■ recent U.S. Census Bureau report. With only 0.5 percent of its adult population infected, Madagascar has the region's lowest HIV rate; conversely, Swaziland has the highest infection rate (39 percent), and the shortest life expectancy (32 years). Other factors—nutrition, health care, war—contribute to life expectancy, but few nations in the region collect enough data to allow those impacts to be weighed.

Like everywhere else, sub-Saharan Africa has a population that's aging at ■ record rate, even with the AIDS pandemic. The traditional high fertility rates keep the elderly set proportionally small, but the total number of those over 60 will nearly double, to 69 million, by 2030, making this one of the world's fastest growing sexagenarian populations. It's a demographic shift that will present major challenges. For one thing, most of these countries don't have social programs to deal with lots of people living six decades—meaning ■ region used to burying its young will have to find new ways to grow old. *—Peter Gwin*

AVERAGE LIFE EXPECTANCY

For people born in 2007, in years

• Island nations smaller than Madagascar are mapped, but not listed on the chart

HIGHEST COUNTRIES	
MADAGASCAR	62.1
ERITREA	59.5
GHANA	59.1
TOGO	57.9
DEM. REPUBLIC OF THE CONGO	57.2

LOWEST COUNTRIES	
LESOTHO	40.0
ZIMBABWE	39.5
ZAMBIA	38.4
ANGOLA	37.6
SWAZILAND	32.2

SOURCE: U.S. CENSUS BUREAU. NGM MAPS. PHOTO: PASCAL MAITRE


HOTEL
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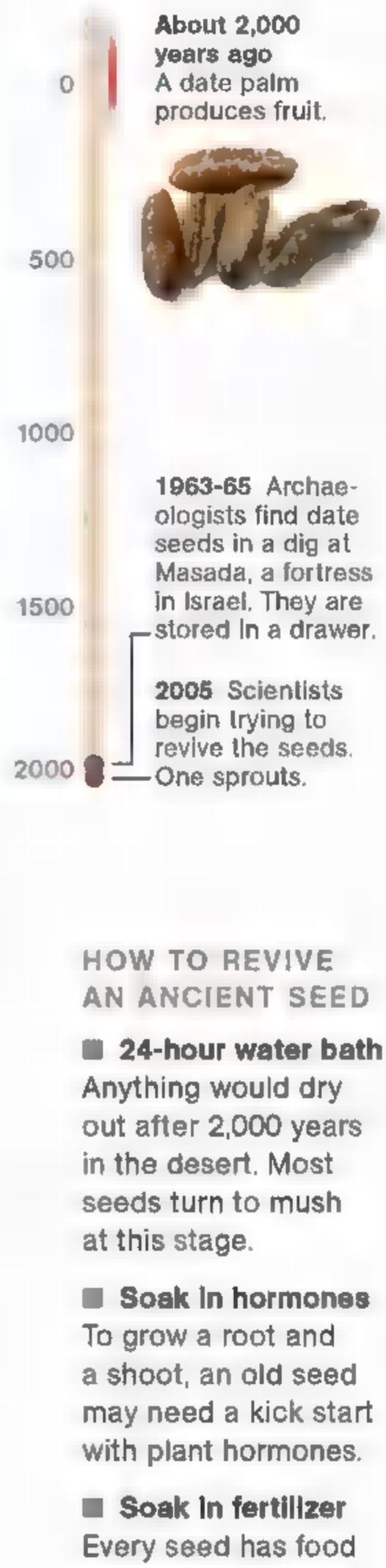
Visit priceless

This five-foot-tall date palm sprang from a seed dug up by archaeologists.



Seeds of Israel's Past Not many people would take 2,000-year-old artifacts, soak them in water, douse them with chemicals, and stick them in dirt. That's what horticulturist Elaine Solowey does with seeds found at Israel's Masada, a cliff-top fortress where Romans in A.D. 73 laid siege to 960 Jews, almost all of whom are said to have committed suicide rather than surrender.

So far, exactly one of her seeds has sprouted: a date palm nicknamed Methuselah. That's good news for gourmands. Ancient Judaea's dates were the sweetest, wrote Pliny the Elder in the first century A.D. But those trees and other crops disappeared as the Jewish presence in the region dwindled; by the time of the Crusades the palms were gone. In 2012 or so, Methuselah will flower, revealing whether it's a female that could bear fruit. "I've got my fingers crossed for a girl," says Solowey. *—Helen Fields*

HOW TO REVIVE AN ANCIENT SEED

- **24-hour water bath**
  Anything would dry out after 2,000 years in the desert. Most seeds turn to mush at this stage.
- **Soak in hormones**
  To grow a root and a shoot, an old seed may need a kick start with plant hormones.
- **Soak in fertilizer**
  Every seed has food for the young plant, but the nutrients go bad over time.
- **Pot it**
  Sterile soil and a new flowerpot give the seed a clean start.
- **Keep it safe**
  Screens ward off bug-borne diseases. A secret locale minimizes human interference.
- **Plant it**
  A date palm can't grow to maturity in a pot.

PHOTOS GUY EISNER

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STAR ALLIANCE MEMBER

GOOD Decisions

MARK Thiessen

FANNING The Flame

> "Mapping environment was incredibly fun, pulling images from my mind."

Some folks have an inkling of their path early in life. *National Geographic* photographer Mark Thiessen is one of those people. When he was just a paperboy of 14, Thiessen dreamed of having his finger on the shutter button. "I saved up my route money and bought a fire and police scanner so I could hear the local news," shares Thiessen, who has worked as a photographer for many years. "Because I didn't have a license, my mother would have to drive me around to photograph stories." The day his pictures made the cover of the newspaper he was delivering, Thiessen became hooked.

Today his work is widely published within the National Geographic Society. His coverage of wildfires and firefighters in the American West is his proudest achievement to date. To prepare, Thiessen spent summers in Boise, Idaho watching scorching fires, and he completed a fire training certification course so he could safely get up-close access to fires. More than fire, the story is about "forest health, fire science, homebuilding policy, and keeping our homes fire smart," says Thiessen. Through the work, Thiessen hopes readers will understand how to live with the reality of fire.

Thiessen attributes his successful career to his early tenacity and a series of good decisions. Through study, internships, and "talking to any photographer I could" he claims doors have opened up for him. "I tell young people just be motivated, conscientious, and focused on what you want to do and you'll be rewarded," he says. "If you keep a good work ethic, you'll come out just fine."

Photographs made possible by NATIONAL GEOGRAPHIC Image Collection

What is the sign of a good decision?

After planning a vacation without a TV,

it's the entertainment you find instead.

In the world of personal finance, it's

MassMutual FINANCIAL GROUP®

You make good decisions every day. Like the one you make when you choose MassMutual. We have one of the broadest product lines around, and a AAA financial strength rating from Standard & Poor's.† And we're owned by our policyholders, which means our clients' needs come first. Make your next decision a good one. Talk to your advisor or visit MassMutual.com

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CRUSTACEAN CHOREOGRAPHY
The crab courtship dance, in four easy-to-follow steps.

1. Lift swimming legs high and stand tall.
2. Turn raised legs so the flat part, called the paddle, is aimed toward hidden females.
3. Wave legs either left and right or in a circle, out of synch.
4. Keep claws spread wide apart (think jazz hands).

Sending a Message

Male blue crabs are no wallflowers. In fact, they're not too shy to perform certain wild leg-waving dance moves. This jigging, so far reported in only two crab species, is more than just a flamboyant physical display. It also lets males commune with hard-to-reach, mate-ready females by sending signals through the waves.

The behavior, first described in the 1970s but only recently analyzed, is all about pheromones, says Georgia State chemical ecologist Michiya Kamio. Fertile females have a distinct chemical signature that puts males on alert. But blue crabs live in oceans, bays, and estuaries, where the murky, rocky, and grassy environs make pairing up a tricky task. The solution is that males send a message—standing up tall and paddling their legs overhead to shoot pheromone jets three feet or more toward inaccessible females. Signal received, females scoot out into view and follow the scent trail.

In captive-crab studies, Kamio and colleagues discovered that when logistics aren't an issue, males skip the dancing and proceed straight to mating. If females are inaccessible, whether due to a barrier in a tank (above) or clumps of grass in the wild, males commence the pheromone-fanning dance—suggesting the moves evolved to cope with forces that keep partners apart. *—Jennifer S. Holland*

PHOTO: PETER ESSICK

TOP SAFETY PICK

★★★★★ 5-STAR RATING FOR SIDE-IMPACT CRASH SAFETY

The All-New 2009 Nissan Murano

Starting at $26,870. Style and safety coexist in the Murano, which not only earned a 5-star government safety rating for side-impact crash safety; but was the first 2009 mid-size SUV to receive an IIHS Top Safety Pick.** Protection comes from high-strength steel construction and a six-air-bag system. Prevention comes from Vehicle Dynamic Control™ and advanced ABS. The all-new Murano is the only crossover to bring it all to you before anyone else. For more information, visit us at **NissanUSA.com.**

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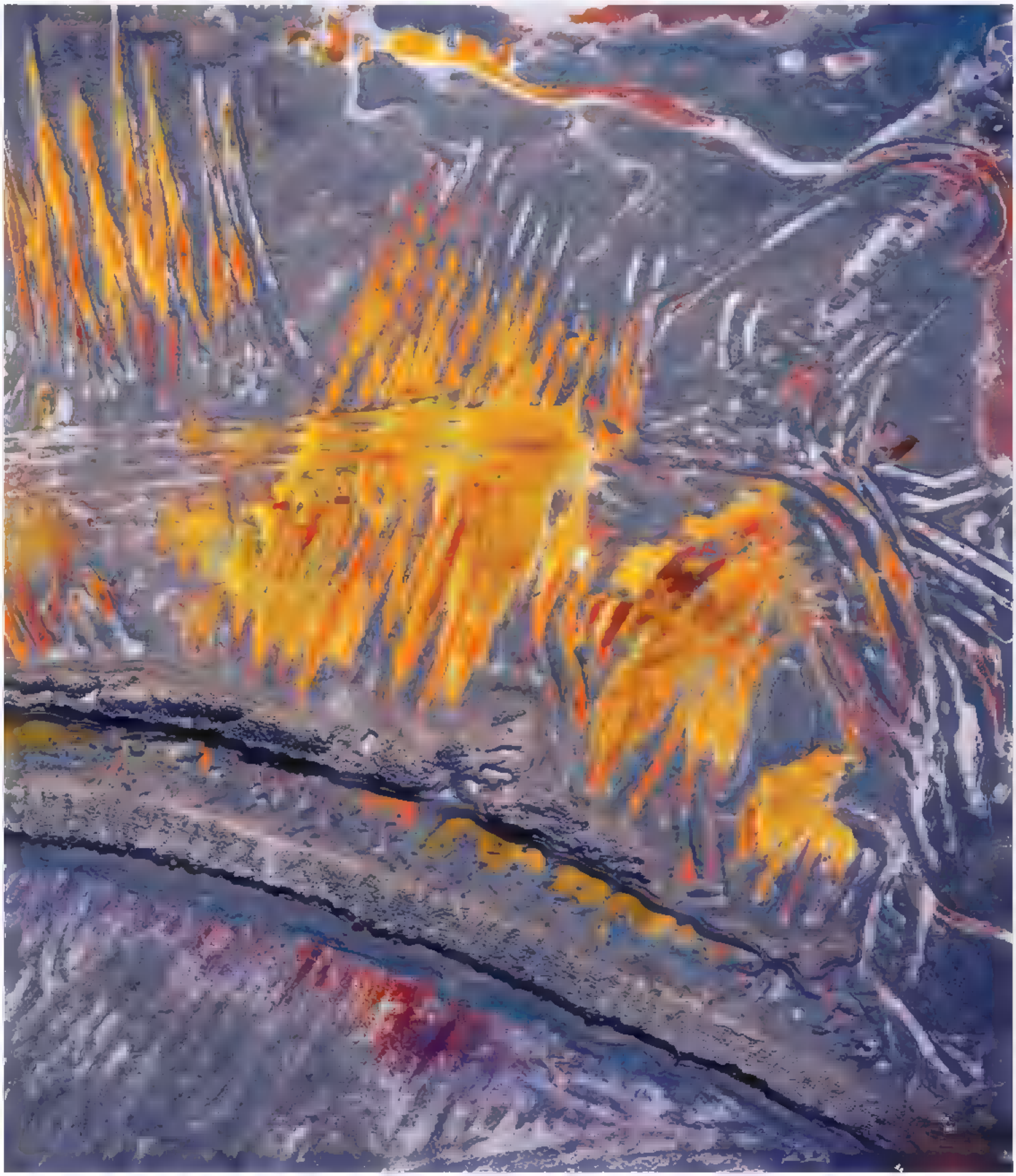
AS SHOWN, $39,470: Murano LE AWD with navigation and dual panoramic sunroof. Price as MSRP excluding tax, title, license and destination charge. Dealer sets actual price. *Government star ratings are part of the National Highway Traffic Safety Administration's (NHTSA) New Car Assessment Program. www.safercar.gov. Model tested with optional side airbags. **Based on 2008 IIHS testing. ^Available electronic stability control system. Always wear your seat belt. Even with the most advanced safety features, you can't change the laws of physics. ^^Based on 12 and under-hood side-impact test results. Actual performance may vary depending on collision circumstances. ^^^Based on 2008 IIHS testing. Actual performance may vary depending on collision circumstances. Always wear your seat belt and properly secure children. ©2008 Nissan North America, Inc.

WHERE IN THE WORLD?



Colorful bacteria and minerals contrast with Owens Lake's dry bed in southeastern California.

Dust Busters Gouges torn into the dry bed of California's Owens Lake, empty for decades, take on startling hues: bloodred from halophilic, or salt-loving, bacteria that thrive in briny puddles; orange from minerals in the groundwater. Earth-moving vehicles created the ruts in an ongoing project to direct water flows over the lake bed, which measures 110 square miles. The goal is to suppress dust that blows off the massive salt flat and plagues the Owens Valley. The growing thirst of an expanding Los Angeles sucked the lake dry more than 80 years ago. *—Chris Carroll*

PHOTO: VINCENT LAFORET

Jess Jackson, Upper Hawkeye Mountain Estate, Alexander Valley

KENDALL-JACKSON

Terroir can be defined as that mystical melding of light, water, soil, air and human touch. It is a definition I often use. The simple fact is, you must have a world-class grape in order to make a world-class wine. And when it comes to grapes, their source, the land is what matters.

Precious few places exist on this Earth that will produce grapes of this caliber. We have been fortunate to find several of those places in California's cool coastal mountains, hillsides, ridges and benchlands. It is some of the best land in California. And why you will see the Jackson Estates Grown designation proudly displayed on our labels.

My family and I have made it our life's work to seek out these special places, have the knowledge and respect to work in concert with Mother Nature, then commit to the hard work, expense and patience to steward the wine into the bottle. It is a commitment many in our industry are either unwilling or unable to make. But we are convinced you can and will taste the difference because, ultimately, the wine's distinct personality will reflect its source, the special terroir.

I understand that many of you enjoy the taste of our wines but you aren't sure why. My goal is to help with **A Taste of the Truth.**

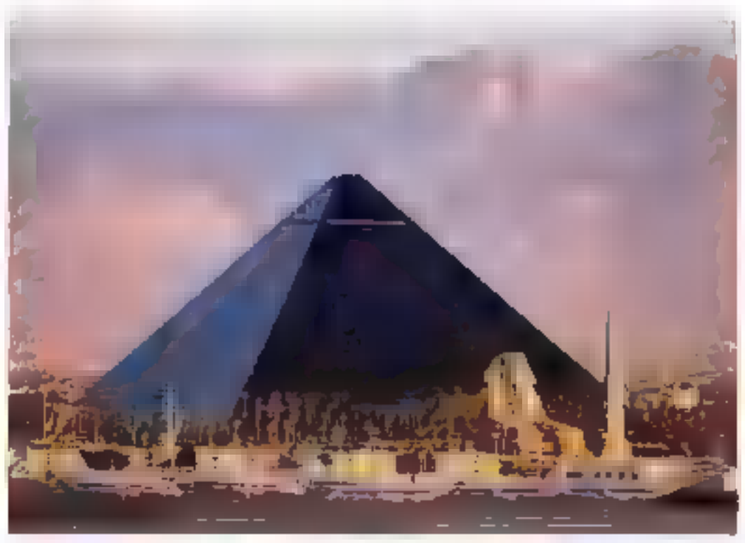
Jess Jackson

kj.com/truth

New York's iconic Guggenheim Museum opened in 1959.

Landmark Decision Egypt is irked: More folks go to Las Vegas, home of a phony pyramid (below) and other ersatz Egyptiana, than visit the Nile landmarks. The country wants to copyright its treasures, requiring permission and ■ fee to make a fake. "The funds will help preserve these monuments," says Zahi Hawass, Egypt's chief archaeologist and ■ Geographic explorer-in-residence.

Lawyers say the pyramids are too old to protect. But new buildings are in luck. Since 1990, U.S. law has extended copyright protection from architectural plans to the structures themselves. An edifice can also try to trademark its image to control commercial use. Few succeed. The Guggenheim Museum did, and now OK's some pitches—for a fee. An ad with ■ classy car driving out of the museum? Sure. Beer that foams in a spiral à la museum curves? Not arty enough. —*Marc Silver*



BUILDING A CASE

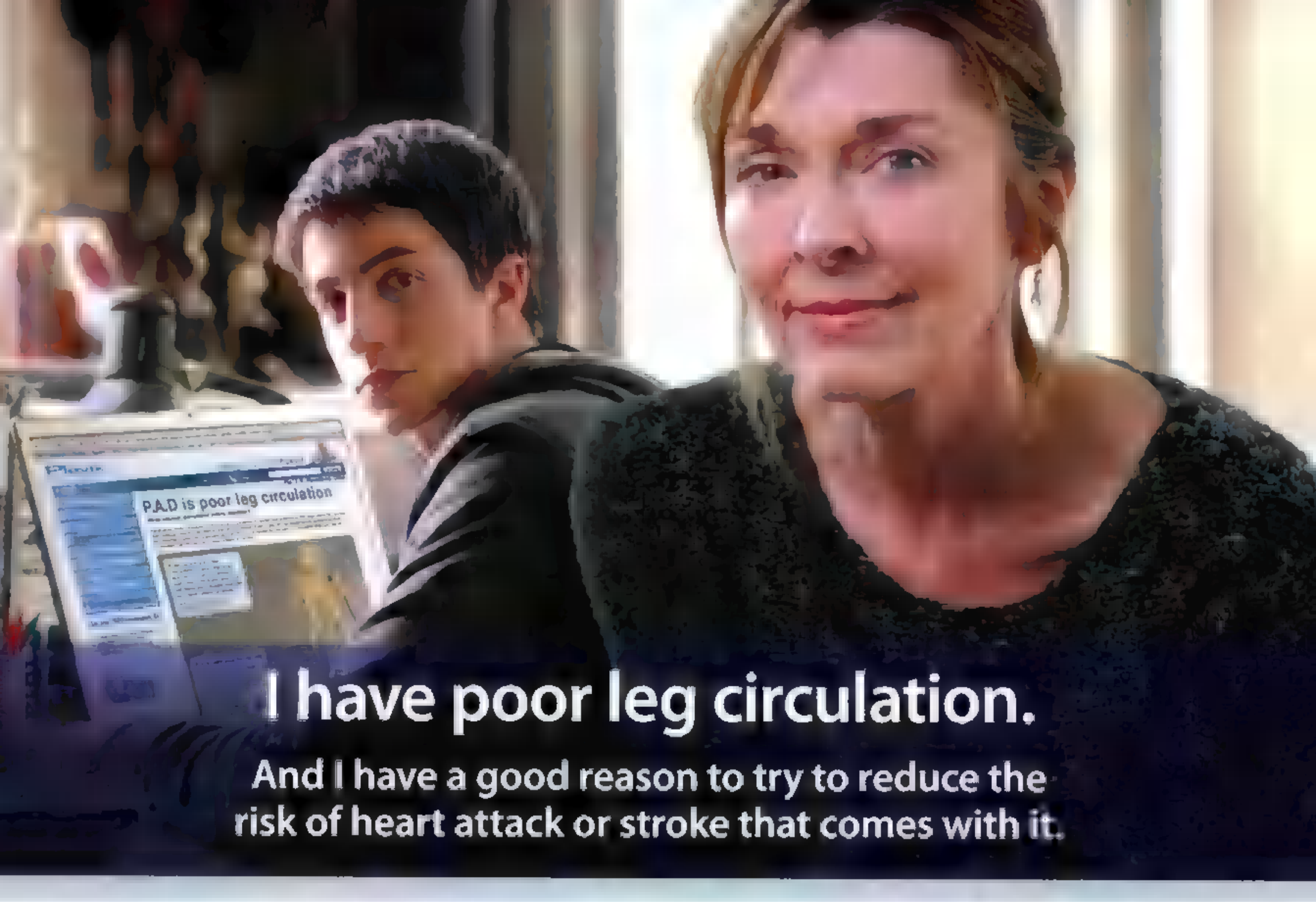
To register its trademark, the Guggenheim pointed to three elements:

■ **A distinctive look** Frank Lloyd Wright's facade fits the bill.

■ **A mission** It's ■ source of art education. A mere office building would likely fall short.

■ **A linkup of mission and image** The museum has extended its brand by putting a depiction of the building on some of its products.

PHOTOS: JEFF ALBERTSON, CORBIS (TOP); B.S.P.I./CORBIS



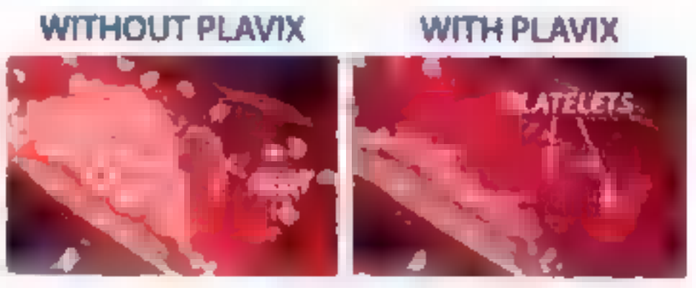
I have poor leg circulation.

And I have a good reason to try to reduce the risk of heart attack or stroke that comes with it.

Plavix can help

Peripheral Artery Disease (P.A.D.) is often described as poor leg circulation, which puts you at double the risk of heart attack or stroke. That's because, if you have poor blood circulation in your legs, you may also have it in your heart and brain. You may feel nothing, but the most common symptom of P.A.D. is pain or heaviness in the legs.

Take the next step. So if you're diagnosed with P.A.D., ask your doctor about a treatment clinically



proven to help reduce your risk of heart attack and stroke associated with P.A.D. PLAVIX helps keep blood platelets from sticking together and forming dangerous clots, the cause of most heart attacks and strokes. Ask your doctor about PLAVIX.

To learn more, talk to your doctor today or visit www.plavix.com/PAD or call 1-888-242-9987.

IMPORTANT INFORMATION: If you have a stomach ulcer or other condition that causes bleeding, you should not use PLAVIX. When taking PLAVIX alone or with some other medicines including aspirin, the risk of bleeding may increase so tell your doctor before planning surgery. And, always talk to your doctor before taking aspirin or other medicines with PLAVIX, especially if you've had a stroke. If you develop fever, unexplained weakness or confusion, tell your doctor promptly as these may be signs of a rare but potentially life-threatening condition called TTP, which has been reported rarely, sometimes in less than 2 weeks after starting therapy. Other rare but serious side effects may occur.

Please see important product information on following page.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

Plavix.
(clopidogrel bisulfate) 75mg tablets

Help reduce your risk of heart attack or stroke.

If you need help paying for prescription medicines, you may be eligible for assistance. Call 1-888-4PPA-NOW (1-888-477-2669), or go to www.pparx.org.

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Plavix®

(clopidogrel bisulfate) 75mg

WHO IS PLAVIX FOR?

PLAVIX is a prescription-only medicine that helps keep blood platelets from sticking together and forming clots.

PLAVIX is for patients who have:

- had a recent heart attack.
- had a recent stroke.
- poor circulation in their legs (Peripheral Artery Disease).

PLAVIX in combination with aspirin is for patients hospitalized with:

- heart-related chest pain (unstable angina).
- heart attack.

Doctors may refer to these conditions as ACS (Acute Coronary Syndrome).

Clots can become dangerous when they form inside your arteries. These clots form when blood platelets stick together, forming a blockage within your arteries, restricting blood flow to your heart or brain, causing a heart attack or stroke.

WHO SHOULD NOT TAKE PLAVIX?

You should NOT take PLAVIX if you:

- are allergic to clopidogrel (the active ingredient in PLAVIX).
- have a stomach ulcer
- have another condition that causes bleeding.
- are pregnant or may become pregnant.
- are breast feeding.

WHAT SHOULD I TELL MY DOCTOR BEFORE TAKING PLAVIX?

Before taking PLAVIX, tell your doctor if you're pregnant or are breast feeding or have any of the following:

- gastrointestinal ulcer
- stomach ulcer(s)
- liver problems
- kidney problems
- a history of bleeding conditions

WHAT IMPORTANT INFORMATION SHOULD I KNOW ABOUT PLAVIX?

TTP: A very serious blood condition called TTP (Thrombotic Thrombocytopenic Purpura) has been rarely reported in people taking PLAVIX. TTP is a potentially life-threatening condition that involves low blood platelet and red blood cell levels, and requires urgent referral to a specialist for prompt treatment once a diagnosis is suspected. Warning signs of TTP may include fever, unexplained confusion or weakness (due to a low blood count, what doctors call anemia). To make an accurate diagnosis, your doctor will need to order blood tests. TTP has been reported rarely, sometimes in less than 2 weeks after starting therapy.

Gastrointestinal Bleeding: There is a potential risk of gastrointestinal (stomach and intestine) bleeding when taking PLAVIX. PLAVIX should be used with caution in patients who have lesions that may bleed (such as ulcers), along with patients who take drugs that cause such lesions.

Bleeding: You may bleed more easily and it may take you longer than usual to stop bleeding when you take PLAVIX alone or in combination with aspirin. Report any unusual bleeding to your doctor.

Geriatrics: When taking aspirin with PLAVIX the risk of serious bleeding increases with age in patients 65 and over.

Stroke Patients: If you have had a recent TIA (also known as a mini-stroke) or stroke taking aspirin with PLAVIX has not been shown to be more effective than taking PLAVIX alone, but taking aspirin with PLAVIX has been shown to increase the risk of bleeding compared to taking PLAVIX alone.

Surgery: Inform doctors and dentists well in advance of any surgery that you are taking PLAVIX so they can help you decide whether or not to discontinue your PLAVIX treatment prior to surgery.

WHAT SHOULD I KNOW ABOUT TAKING OTHER MEDICINES WITH PLAVIX?

You should only take aspirin with PLAVIX when directed to do so by your doctor. Certain other medicines should not be taken with PLAVIX. Be sure to tell your doctor about all of your current medications, especially if you are taking the following:

- aspirin
- nonsteroidal anti-inflammatory drugs (NSAIDs)
- warfarin
- heparin

Be sure to tell your doctor if you are taking PLAVIX before starting any new medication.

WHAT ARE THE COMMON SIDE EFFECTS OF PLAVIX?

The most common side effects of PLAVIX include gastrointestinal events (bleeding, abdominal pain, indigestion, diarrhea, and nausea) and rash. This is not a complete list of side effects associated with PLAVIX. Ask your doctor or pharmacist for a complete list.

HOW SHOULD I TAKE PLAVIX?

Only take PLAVIX exactly as prescribed by your doctor. Do not change your dose or stop taking PLAVIX without talking to your doctor first.

PLAVIX should be taken around the same time every day, and it can be taken with or without food. If you miss a day, do not double up on your medication. Just continue your usual dose. If you have any questions about taking your medications, please consult your doctor.

OVERDOSAGE

As with any prescription medicine, it is possible to overdose on PLAVIX. If you think you may have overdosed, immediately call your doctor or Poison Control Center, or go to the nearest emergency room.

FOR MORE INFORMATION

For more information on PLAVIX, call 1-800-633-1610 or visit www.PLAVIX.com. Neither of these resources, nor the information contained here, can take the place of talking to your doctor. Only your doctor knows the specifics of your condition and how PLAVIX fits into your overall therapy. It is therefore important to maintain an ongoing dialogue with your doctor concerning your condition and your treatment.

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WILDLIFE

Wild Turkeys Take Off Wild turkeys terrorize a family in Brookline, Massachusetts, pecking so hard at the back door they leave a mark. An animal-control officer on patrol spots five birds and thinks they could be the perps. He approaches. The three females flee; the two males attack. One flies in his face; another goes for his knee, drawing so much blood he calls an ambulance.

A Stephen King Thanksgiving tale? Not quite. It's a true story—and one downside to the comeback of a magnificent, muscular bird. Hunters and habitat loss nearly wiped out wild turkeys. A century ago there were only 30,000 in the U.S. Today, thanks to careful stewardship by public and private groups, there are about seven million—so many that licensed hunters can take aim in season.

But turkey-human standoffs are rising as the forest dwellers visit suburbia for easy eats. Shoo the birds or brandish a broom, advises Chris Leahy of the Massachusetts Audubon Society. If that fails, says Pierre Verrier, the wounded officer: "Hit them—hard." *—Marc Silver*

25 miles an hour
Maximum running speed, in short bursts

55 miles an hour
Maximum flying speed, also in short bursts

15 percent
Approximate share of wild turkeys killed by hunters each year

The wild turkey, a forerunner to the domesticated bird, can stand four feet tall at full strut.

PHOTO: DAVID J. SAMS

To our leaders:

Free us from our addiction to oil.

Free us from $4.00/gallon gas.

Free us from $4.39/gallon gas.

Free us from $4.61/gallon gas.

Save our economy.

Save us from this climate crisis.

Give us truly clean energy.

Use the wind.

Use the sun.

we demand that we use them.

we demand that we Repower America.

There is a solution.

There is no time to waste.

we, the American people,

demand a better future.

Give us 100% clean electricity within 10 years.

Go to wecansolveit.org and join us.

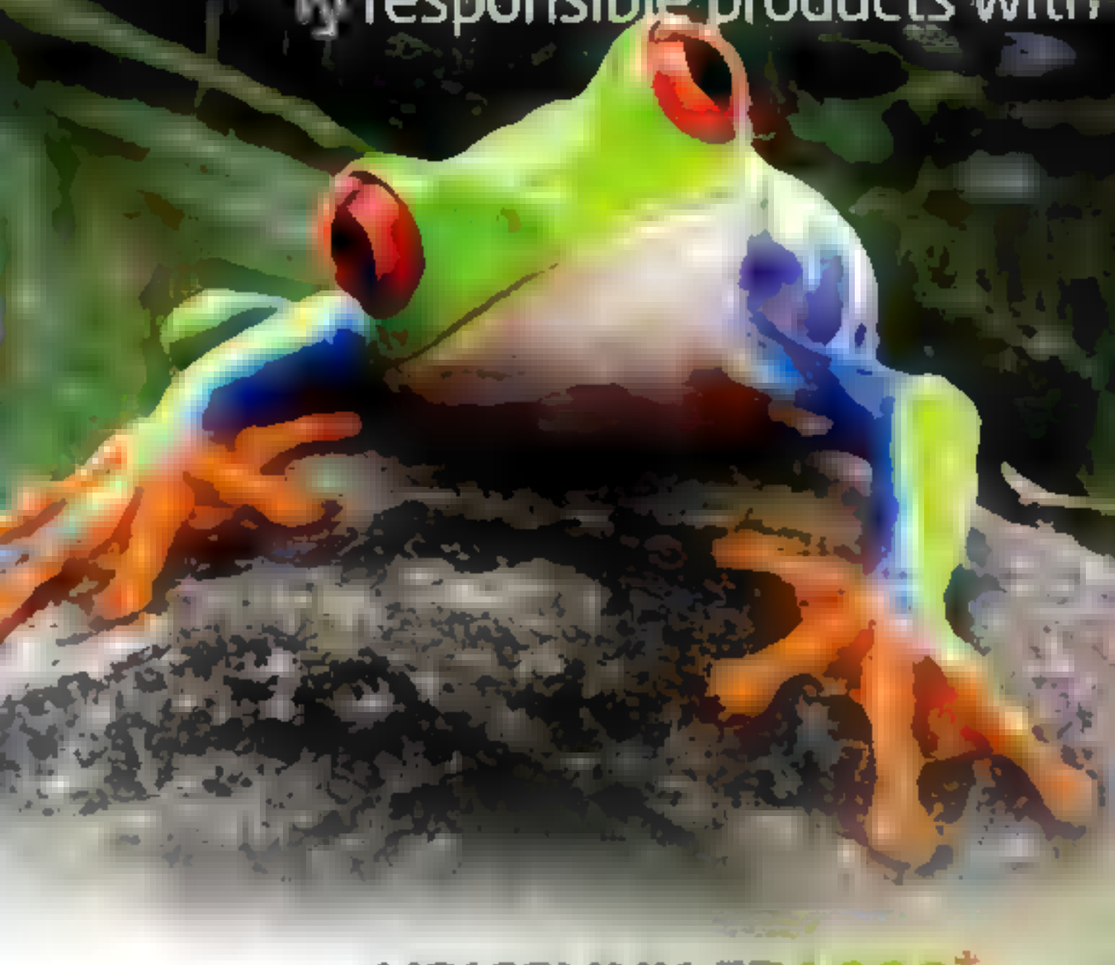
Together we can Repower America.

Together we can solve the climate crisis.

Join us today.

Tune_in: To Green Power On Your Next Adventure

You march to your own beat, and so does Eton. With the newest members to our crank radio platform, we are committed to developing socially responsible products with incredible design and independent energy.



VOICELINK FR1000*

Self-Powered AM/FM/NOAA Weather Radio with Flashlight, Alert Beacon, Siren, GMRS Walkie Talkie Function, Hand Crank Power & Cell Phone Charger

SOLARLINK FR500*

Self-Powered AM/FM/Shortwave & NOAA Weather Radio with Flashlight, Solar Power, Hand Crank Power & Cell Phone Charger

MICROLINK FR150

Self-Powered AM/FM/NOAA Weather Radio with Flashlight, Solar Power, Hand Crank Power & Cell Phone Charger

reddot design award winner 2008

INTERNATIONAL DESIGN EXCELLENCE AWARDS '08

*SOLARLINK FR500 / VOICELINK FR1000 have received RedDot Award & International Design Excellence Awards

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1-800-793-6542

Purposeful Heart During the seven years of fighting in Afghanistan and Iraq, an average of 14 Americans each day have earned Purple Hearts, the military decoration for being killed or wounded in combat. Conceived by George Washington as the Badge of Military Merit to laud exemplary service by the Continental Army's enlisted men, the first Purple Hearts went to three Revolutionary War sergeants. Traditionally, medals had been reserved for officers. The award fell into disuse until after World War I, when the military found itself lacking a medal for soldiers whose valorous actions didn't merit a Distinguished Service Medal. The Purple Heart was revived in its modern form in 1932, the 200th anniversary of Washington's birth, and 13 years later nearly a million World War II troops had merited one. Anticipating a bloody invasion of Japan, the Pentagon ordered hundreds of thousands—a supply that outlasted both the Korean and Vietnam Wars and wasn't exhausted until 2000.

In recent decades Purple Hearts have been awarded for injuries in unconventional conflicts: the takeover of the U.S. Embassy in Iran, peacekeeping actions, and terror attacks. Totals for past wars are increasing as wounded veterans who were overlooked have petitioned for the award. Now debate is rising over what counts as a wound worthy of the medal, with some in the Pentagon arguing that victims of post-traumatic stress disorder should qualify. *—Peter Gwin*

George Washington said the Badge of Military Merit (above, one of three originals) should be "the figure of a heart made of purple cloth or silk."

HARD NUMBERS

Any tally of Purple Hearts is an estimate. Awards are often given during conflict; records aren't always exact.

♥ = *1,000 military personnel killed or wounded*

World War II: 964,409

Korea: 136,936

Vietnam: 200,676

Persian Gulf: 590

Afghanistan: 2,743 (as of 8/21/08)

Iraq: 33,923 (as of 8/21/08)

PHOTO: NEW WINDSOR CANTONMENT STATE HISTORIC SITE
SOURCE: DEPARTMENT OF DEFENSE

make way for oil palm tion, land Sarawak, Malaysian Borneo, is stripped of trees, then burned. Palm oil is a prime export for Malay Indonesia, and global demand growing.

BORNEO'S MOMENT OF TRUTH

THE MAJESTIC FORESTS ARE VANISHING IN SMOKE AND SAWDUST, BUT THERE'S STILL HOPE FOR THE ISLAND'S FABLED BIODIVERSITY—IF THE PALM OIL RUSH CAN BE SLOWED.

BY MEL WHITE PHOTOGRAPHS BY MATTHIAS KLUM

Native lowland forest still flourishes in Malaysia's Danum Valley Conservation Area, where skyward-snaking lianas twine around dipterocarp trees that stand more than 150 feet tall. Divided among the nations of Malaysia, Indonesia, and Brunei, Borneo supports at least 15,000 known species of plants.

Clinging to the hand of a human protector six-year-old Mugi — one of some 500 orphans cared for at the Nyaru Menteng Orangutan Rescue Center in Indonesian Borneo. The island's orangutans are endangered. The population has fallen by more than 50 percent in the past 50 years.

First, I will tell you about the Borneo of your dreams.

The day starts well before dawn with the lunatic hooting of gibbons, the rain forest's alarm clock, lovers and rivals wooing and warning each other from the treetops in an urgent ape language that I, their terrestrial relative, can only guess at.

From my camp a creekside trail leads into forest past trees whose massive trunks rise a hundred feet to the lowest branches. As sunlight makes its feeble way through the dense green canopy, another primate, a long-tailed macaque, walks along the stream below, hoping for a breakfast of fish or frog. Whether it's successful or not, its expression of perpetual irritation will never change. No sooner has the monkey disappeared upstream than a pair of short-tailed mongooses bound down to the bank, seemingly more intent on fun than food.

At a clearing, a pair of rhinoceros hornbills fly to a fruiting tree on loud-whooshing wings and begin to feed. Mostly black, nearly the size of turkeys, they have huge red-and-yellow casques on their bills that gleam in the sun like polished lacquer. The birds outshine everything else in the forest until a hand-size shape flits erratically past at waist level, deep velvety black, but also crimson and electric green, screaming neon green, a color as gaudy as the name of this creature: Rajah Brooke's birdwing. At almost seven inches across, it's one of the largest butterflies in the world. If the rhinoceros hornbill doesn't take your breath away—if the Rajah Brooke's birdwing doesn't—have someone hold your wrist and check for a pulse.

Later I take a small boat down a broad river called the Kinabatangan, then up a side channel as narrow as an alleyway. A troop of proboscis monkeys climb through the branches overhead, where they will spend the night in tall trees beside the water. The potbellied male, ridiculously outsize nose hanging from his face like a ripe fruit, is so ugly he's endearing, in a kind of bibulous-old-uncle way. Most of the pointy-nosed females under his watch cradle young at their breasts. Silvered leaf monkeys look down from above, and a bearded pig stands just inside the forest to watch us pass. As the boat drifts below an overhanging branch, a four-foot-long water monitor lizard drops into the water.

A Borneo pygmy elephant enters the river and swims in front of the boat, blowing like a whale. "Pygmy" it may be in comparison to other elephants, but when it emerges dark and shining on the opposite bank, it's as if an island is rising from the sea. I see where it's going: A herd of around 30 animals—a long-tusked bull, many adult females, and various young—munch tangled vines beside the main river, expressionless as statues and only marginally more animated.

This is the mythic Borneo, the island of the world's imagination, and it's all as wondrous as it sounds. But if you want to see the real Borneo, the Borneo of the first decade of the 21st century, it would be good to be the crested serpent-eagle perched in a tree across the river. Then you could soar high above the Kinabatangan and see how quickly the unruly forest gives way to neatly planted rows of oil palm trees, stretching for mile after mile in all directions. The palm plantation is lush and green,

Only about a thousand Borneo pygmy elephants survive in the wild. Their optimal habitat is lowland forest—much now lost to development.

and the arching fronds of the trees give it an exotic beauty, and for the incomparable biodiversity of Borneo it is inexorable death.

Set between the South China and Java Seas, bisected by the Equator, the island of Borneo has served throughout human history mostly to have its natural resources exploited—many would say plundered—by a succession of peoples from around the world.

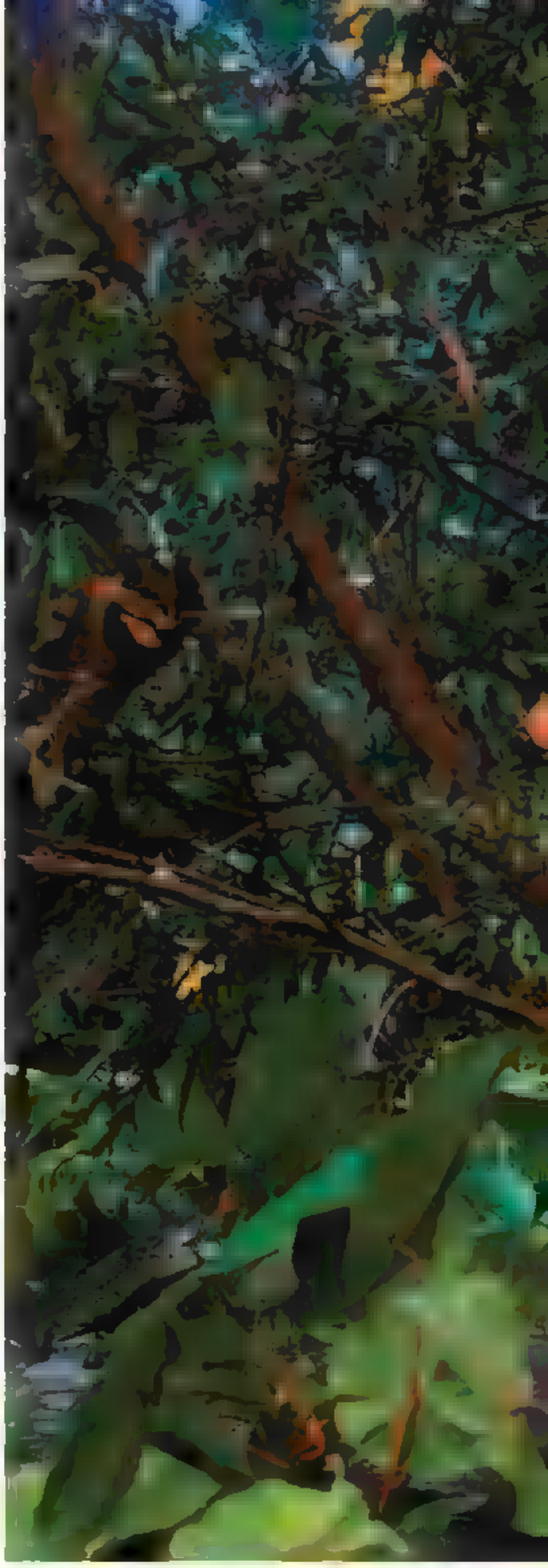
Chinese traders came for rhinoceros horn, the aromatic wood called *gaharu*, and birds' nests for soup. Later, Muslim and Portuguese traders joined them to export pepper and gold. Britain and the Netherlands controlled the island during the colonial period of the 19th and early 20th centuries, when loggers began cutting the tropical hardwood forest covering the island. The current political division of Borneo—the southern three-quarters belongs to Indonesia, most of the rest to Malaysia, with slivers that make up Brunei—reflects alliances of the British and Dutch colonial era, which ended with independence after World War II.

In recent decades, companies from Europe, the United States, and Australia have drilled for abundant oil and natural gas and strip-mined coal. There are mansions from Amsterdam to Melbourne, from Singapore to Houston, that were built with wealth from Borneo. Mansions built with Borneo wealth stand in Jakarta and Kuala Lumpur, too, because Indonesia and Malaysia, or at least the political and economic elite, have been the biggest plunderers of all.

A different kind of richness has attracted others, including the great naturalist Alfred Russel Wallace, who spent time here in the mid-1850s while he developed theories important to modern understanding of evolution and biogeography. Wallace collected more than a thousand species new to science, including Rajah Brooke's birdwing. Scientists have continued making discoveries ever since, demonstrating that the rain forest of Borneo ranks with the most biologically diverse places on Earth.

Borneo has more than 15,000 known species of plants, including more than 2,500 species of orchids. Southeast Asia's lowland forests, including Borneo's, are the tallest tropical rain forests in the world, and may have as many as 240 species of trees on a single four-acre site. Borneo is home to the world's largest flower, the world's largest orchid, the world's largest carnivorous plants, and the world's largest moth. In the multilevel structure of Borneo's rain forest lives the world's largest collection of gliding animals: Apart from several species of flying squirrels there are flying lizards, flying colugos, flying frogs, and—the stuff of nightmares for some—flying snakes.

Sun bears and clouded leopards roam Borneo's



Dense thickets muffle the whine of chain saws in the Malaysian state of Sarawak, where loggers seek trees that are big enough to be profitable. Regulating the timber trade remains a challenge on this multinational island, prompting conservationists to call for joint management of Borneo's forests.

Mel White, based in Arkansas, and Sweden-based Mattias Klum, both regular contributors to the magazine, cover natural history and the environment.

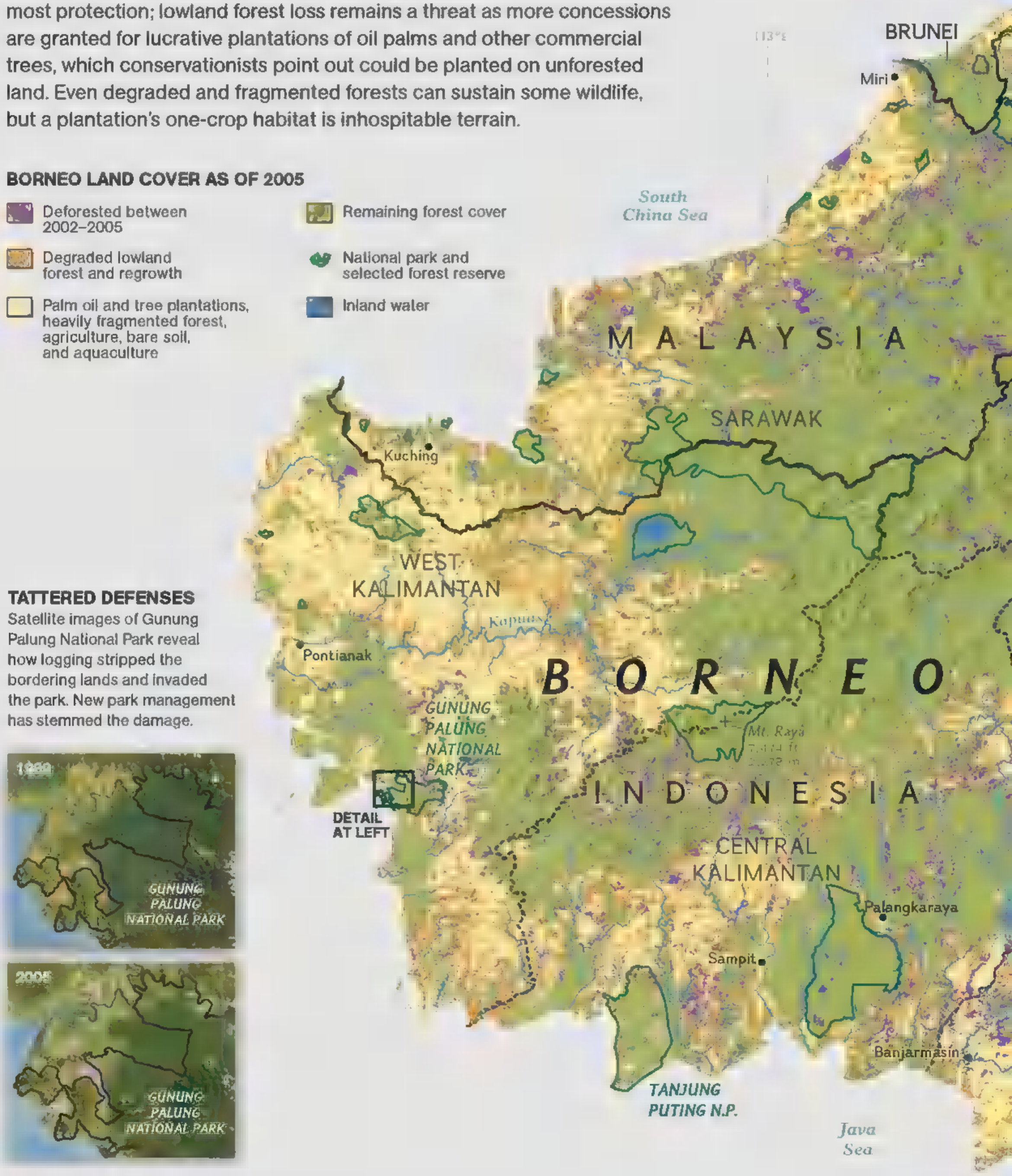
forests, while two species of gibbons and eight species of monkeys climb in the trees. Around a thousand elephants have survived in one corner of the island—mostly in the Malaysian state of Sabah, where the Kinabatangan River runs to the Sulu Sea. Rhinoceroses barely hang on to existence, with fewer than four dozen remaining. But it's an even more charismatic animal—the orangutan—that has become the symbol of Borneo. Its expressive eyes stare out from the newsletters and funding appeals of conservation groups around the world. Considering the island's unsurpassed biodiversity—from orangutans and rhinoceroses to tiny mosses and beetles not yet discovered—and the rate at which its forests are being lost, Borneo's future may well be the most critical conservation issue on our planet.

From a satellite perspective, the threat of Borneo's imminent deforestation might seem overstated. The island, slightly larger than Texas, is still half covered with trees, and in the interior highlands stand hundreds of square miles of virgin forests where almost no one goes save indigenous hunters, wildlife poachers, and gaharu gatherers. Reaching some areas requires a boat trip of several days or strenuous hikes through pathless wilderness.

But it's an entirely different story, and an increasingly desperate one, for lowland forests, the prime habitat for most of Borneo's wealth of biodiversity, including orangutans and elephants. During the past two decades, an estimated two million acres were cleared annually, an area more than half the size of Connecticut. A paper in *Science* magazine in 2001—ominously titled

VANISHING FORESTS

Logging on Borneo kicked into high gear in the 1970s, and for decades the island provided much of the world's tropical hardwoods. About half its forest cover remains. The less accessible central highlands have received the most protection; lowland forest loss remains a threat as more concessions are granted for lucrative plantations of oil palms and other commercial trees, which conservationists point out could be planted on unforested land. Even degraded and fragmented forests can sustain some wildlife, but a plantation's one-crop habitat is inhospitable terrain.

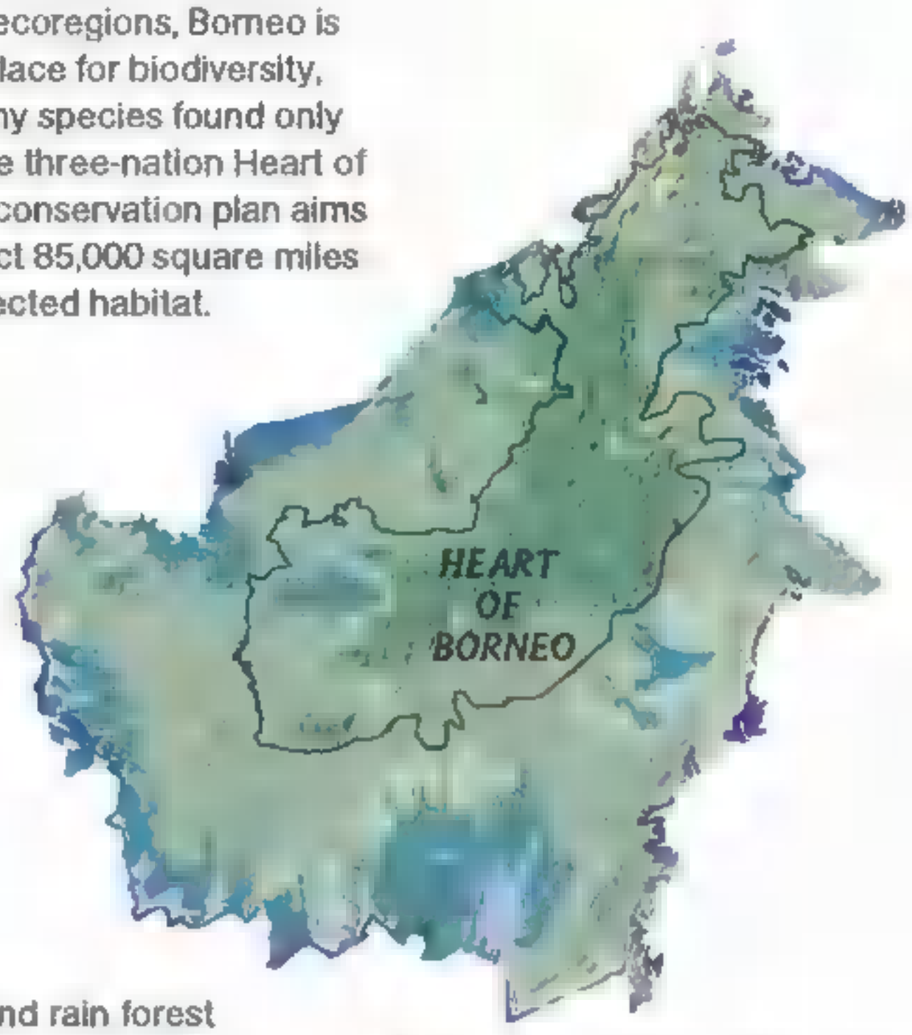


TATTERED DEFENSES
Satellite images of Gunung Palung National Park reveal how logging stripped the bordering lands and invaded the park. New park management has stemmed the damage.

A Wealth of Species

NATURAL HABITATS

A tropical island with seven distinct ecoregions, Borneo is a showplace for biodiversity, with many species found only here. The three-nation Heart of Borneo conservation plan aims to protect 85,000 square miles of connected habitat.



- Lowland rain forest
- Montane rain forest
- Peat swamp forest
- Montane alpine meadow
- Freshwater swamp forest
- Mangrove
- Heath forest

SPECIES DIVERSITY

	Endemic to Borneo	Total
Mammals	44	222
Birds	74	420
Reptiles	91	254
Amphibians	114	149
Fish	160	430
Dipterocarps*	155	267

*TROPICAL HARDWOOD TREES

FATE OF ORANGUTANS

Lowland tree dwellers, Borneo's orangutans have lost most of their historic range. The great apes have a chance to survive if logging is properly managed and illegal trade and hunting stops.

- 2008 range
- Mid-20th century

Sulu Sea
Mt. Kinabalu 13,455 ft 4,101 m
Kota Kinabalu
Sepilok
SABAH
Danum Valley
Kinabatangan
ULU SEGAMA FOREST RESERVE
MALIAU BASIN FOREST RESERVE
Celebes Sea
EAST KALIMANTAN
Long Noran
Sangatta
KUTAI N.P.
Longiram
Mahakam
Samarinda
Balikpapan
ASIA
Kuala Lumpur
Jakarta
BORNEO
AUSTRALIA
625 sq mi 400,000 acres
625 sq km 62,500 hectares
0 mi 50
0 km 50
SOUTH KALIMANTAN

MARTIN GAMACHE AND LISA R. RITTER, NG STAFF

SOURCES: ANDREAS LANGNER, JUKKA MIETTINEN, AND FLORIAN SIEGERT, *GLOBAL CHANGE BIOLOGY*, NOVEMBER 2007; RONA DENNIS; WWF-GERMANY; INDONESIAN MINISTRY OF FORESTRY; WWF-U.S. (ECOREGIONS, MODIFIED); WILDFINDER DATABASE (DIVERSITY); ERIK MEIJAARD AND HERMAN RIJKSEN (ORANGUTANS)
SATELLITE IMAGES: GLOBAL LAND COVER FACILITY (TOP); CRISP, NATIONAL UNIVERSITY OF SINGAPORE

Oil palm – now the primary cause of permanent rain forest loss

"The End for Indonesia's Lowland Forests?" —warned of the "dire consequences" of "the current state of resource anarchy" and cited a study predicting that lowland forests in Indonesian Borneo could be totally destroyed by 2010. While government crackdowns have slowed illegal logging and exports, the result has simply been to delay the forecast doomsday.

Other factors could speed it up again. In the past 20 years vast, single-crop plantations of oil palm have spread across Borneo to meet the demand for the versatile (and vastly profitable) oil derived from its fruit. Palm oil is used for cooking, and in cosmetics, soap, desserts, and a seemingly endless list of other products, including biofuel. Indonesia and Malaysia provide 86 percent of the world's supply; growing conditions are perfect on Borneo for this green gold. Even as conservationists spread the news about palm oil's contribution to global deforestation—some calling for boycotting of palm oil products—Indonesia has become the world's number one producing country, with 15 million acres under cultivation, a figure that may double by 2020.

As if the oil palm monoculture weren't enough, Borneo possesses another resource that combines economic blessing and environmental danger: The 300-million-year-old plant material that once grew on what is now Borneo lies underground, transformed into coal. Surface mines—for gold as well as coal—spread across southern and eastern Borneo like pockmarks, displacing forest and polluting rivers with waste.

And in a world newly awakened to the dangers of climate change, Borneo has gained global attention for yet another reason: A specialized ecosystem called peat swamp forest covers around 11 percent of the island. Here, trees grow on highly organic soil built of centuries' accumulation of waterlogged plant material. Sometimes reaching a depth of 60 feet, peat soil represents a massive store of the world's carbon. Stripped of its trees and drained, tropical peat decays and releases its carbon into the atmosphere, and as it dries it becomes extremely susceptible to burning, intentional or accidental. Massive annual fires set deliberately to clear previously forested land for new oil palm plantations—and exacerbated by frequent drought—have burned out of control and filled Borneo's skies with smoke, closing airports and causing respiratory problems for millions of people as far away as mainland Asia. Carbon released by decaying peat soil, fires, and deforestation has pushed Indonesia into third place among nations as a source of greenhouse gases, behind only heavily industrialized China and the United States.

Time is running out for Borneo's rain forests. Conventional models offer little hope. Setting aside large areas as parks or reserves, standard practice in the U.S. and other countries, has been largely ineffective, at least on the Indonesian part of Borneo, undermined by inadequate funding, lack of support from local residents, and government corruption. But many conservationists say that logging, often regarded as anathema to wildlife, may, if practiced sustainably, in fact help to protect a significant portion of the island's biodiversity.

"Virgin rain forest is a dead concept now in Borneo," says Glen Reynolds, chief scientist at the Danum Valley Field Center in Sabah. "All of the big areas of primary lowland forest that can be conserved already have been. It's difficult, but now what you've got to do is convince people that what we think of as degraded forest can sustain biodiversity."

The message is complex but ultimately clear. To protect Borneo's forests and wildlife will require rethinking old ideas, accepting new truths, and adopting new models of conservation. And in the end, the fate of Borneo may be decided far from the forests, in government offices and corporate boardrooms from New York to Geneva. Because of the vast amounts of carbon tied up in the plants and soils, the last best hope for Borneo's future may rest not on the emotional appeal of an orangutan's face, but on the hard facts of climate change—and our own determination and ability to protect ourselves from disaster.

On the opposite side of Borneo from Sabah, in the Indonesian province of West Kalimantan, a narrow paved road leads away from Pontianak,

in Indonesia, and the source for the world's top vegetable oil.

a city near the South China Sea. Crowded with trucks and buzzing motorbikes, the road passes wooden shops and houses in small villages separated by rice fields. The harvest has just begun, and here and there people beat sheaves against wooden lattices or toss grains into the air to let the wind carry away the hulls. There's little trace of the forests that once stood here.

I'm traveling with Dessy Ratnasari, a scientist from a local research organization, whose animated face is encircled by a light blue head scarf. Our driver, Harun—who, like many Indonesians, uses only one name—speaks up as we pass a large building fringed with weeds.

"This is a sawmill where he worked," Ratnasari translates. "It went bankrupt because there are no more trees for timber. It had 1,300 workers and a payroll of 800 million rupiah a month"—about $90,000. Within a couple of miles we pass two more mills, gates locked, windows broken, parking lots empty.

"There were several big companies and some smaller mills around Pontianak," Harun says. "Now there's only one big company still operating."

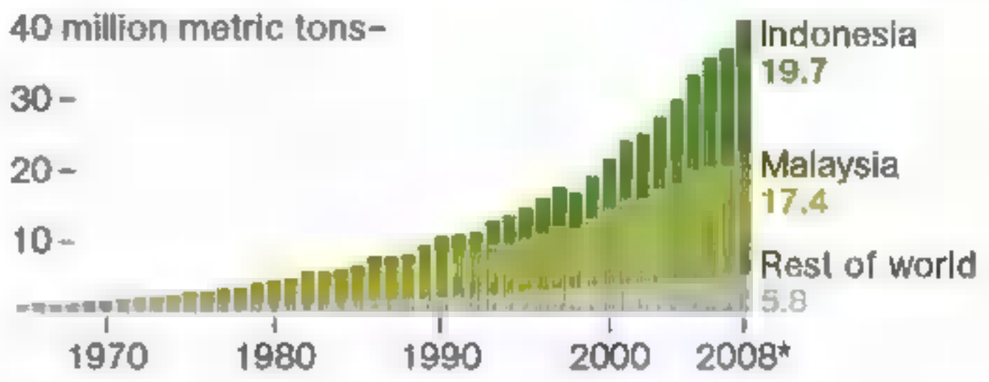
How did nearly a third of the rain forest that stood on Borneo in 1985 disappear by 2005? An easy, and only slightly oversimplified, answer can be found in the initials that Indonesians use as an explanation for many of their country's troubles: *KKN*, for *korupsi, kolusi, nepotisme* (corruption, collusion, nepotism). During the 32-year presidency of Suharto, until he was forced from office in 1998, Indonesian forests were among the many resources treated as personal wealth by him, his family, and military officials who helped keep him in office. Since Suharto, political power has been decentralized, and decision-making about natural resources has become more localized. Unfortunately, too often the result has been what one conservationist calls "the democratization of corruption."

Local officials, having watched Suharto et al. loot the country for decades, began cashing in themselves. Many provincial governors, district *bupati* (regents), and police avidly took bribes: from timber companies, to grant logging permits

The Impact of Oil Palms

PRODUCTION

Indonesia and Malaysia dominate the global palm oil market, with much of it produced on Borneo. Extracted from the fruit of the oil palm, the oil is used in foods, cosmetics, detergents, and biofuel.



FIRES 1997-2007

Fire is the chief way to clear logged land for oil palm plantations and other agriculture. Set in the dry season, fires can quickly spread out of control. The polluting haze affects the health of millions of people across Asia.

CO_2 EMISSIONS

Among the consequences of clearing forest to create farmland: Indonesia trails only China and the U.S. in CO_2 emissions. Cultivating the island's organically rich peat soil also releases massive amounts of carbon.

STEPHANIE GASPERS (TOP AND CENTER); ART BY MARIEL FURLONG, NG STAFF (BOTTOM). SOURCES: FOREIGN AGRICULTURAL SERVICE, USDA (TOP); INTEGRATED FOREST FIRE MANAGEMENT PROJECT AND FIRE INFORMATION FOR RESOURCE MANAGEMENT SYSTEM (CENTER); JOSEPH FARGIONE, NATURE CONSERVANCY (BOTTOM)

in nominally protected forests; from illegal loggers, to ignore intrusions into national parks; and from oil palm companies, to allow wholesale clearing and burning of forestlands for plantations. Chaotically confused jurisdiction and land-ownership issues made matters worse. Although the national government claims to administer forestry laws, provinces and districts often issue land-use permits independently, and conflicting court decisions contributed to the free-for-all atmosphere.

Across the border in Malaysian Borneo, the state of Sarawak has been controlled for 27 years by Chief Minister Abdul Taib Mahmud, whose administration is widely regarded as dictatorial and corrupt. Uncontrolled logging has so greatly depleted Sarawak's forests that most conservationists working to save Borneo's biodiversity have, in a kind of environmental triage, essentially given up and focused their attentions elsewhere on the island. Having ravaged its forests, Sarawak has now turned its attention to its large areas of coastal peat swamp forest, rapidly converting tracts to oil palm despite environmentalists' concerns over carbon emissions.

The natural world fares better in Sabah, the Malaysian state in northeastern Borneo. Though oil palm plantations have burgeoned here, more than half of Sabah remains forested. Much of the forest has been heavily logged, and more and more acres converted to commercial tree plantations, but Sabah sustains some of the best surviving examples of high-quality rain forest: the Danum Valley and Maliau Basin Conservation Areas. (The nation of Brunei has so much money from petroleum that there's been no need to exploit its forests. It retains some of the best rain forest on Borneo, but, since it occupies less than one percent of the island, it makes a negligible contribution to the overall conservation picture.)

"Good governance" is a bureaucratic phrase often used by diplomats and nongovernmental organizations working in Indonesia and Malaysia. What it means in plain terms is removing the hands of politicians and their cronies from the pockets of poor people and opening up government actions to public scrutiny and free debate. Everyone working on conservation in Borneo agrees that no efforts—no laws or regulations, no new parks or protected areas—will be effective without it.

"Governance is almost everything, in that if we can't get it right, nothing else matters," says Frances Seymour of the Center for International Forestry Research (CIFOR), an international organization headquartered in Indonesia and committed to conserving forests and improving the livelihoods of people in the tropics. There have been encouraging signs of progress in Indonesia—at least at the higher levels of government—especially since 2004, when Susilo Bambang Yudhoyono was elected president. Another major step began in 2000 when the national police force loosened ties with the military, a notoriously corrupt organization with long-standing links to illegal logging and smuggling. Even better news came in 2005, when General Sutanto was appointed national chief of police. "No law enforcement head anywhere in the world has made as much progress as he has," a senior U.S. official in Jakarta told me.

Hundreds of arrests for illegal logging activities have been made since then, targeting not just workers in the field (who may make as little as two dollars a day), but also, occasionally, mid-level timber buyers and government officials, including the ex-governor of the Indonesian province of East Kalimantan and many workers in the corruption-tainted Ministry of Forestry. Gunung Palung National Park in West Kalimantan, once a horror story of uncontrolled illegal logging and poaching, has seen a major turnaround thanks to an honest and dedicated director whose rangers patrol the park with ultralight aircraft and motorboats.

On a national level, many Indonesian ministers get high marks, or at least grudgingly awarded passing grades, for their dedication to reform. "And yet I will say that in this village there is no question that it's impossible to get a policeman to do anything without being asked for a bribe," a person connected to a small

biodiversity. Logged forests could be the future for Borneo's wildlife.

conservation group tells me. (As happened often when I talked with activists, I was asked not to name the speaker.) "The bupati has friends in Jakarta who could shut us down," another NGO worker says. "It's a fine line you have to walk here. They could crush us if they wanted to."

In several district capital towns I visited, the most obvious result of increased local autonomy was a showy new government office complex; the second-most-obvious was the bupati's showy new house. "The challenge," Frances Seymour says, "is how we help communities and local governments make better decisions for the long term, because what's going on now is a short-term spasm of making money, and ten years from now jobs are going to be gone and income sources are going to be gone." And the Indonesian hinterlands will remain as poor as ever.

A highway winds through jagged limestone hills in East Kalimantan, following a route that five years ago was a dirt logging road. Today there's nothing but scrub in all directions. Every mile or so, as the highway crosses a ravine, there's a minor cave-in that's caused the lane on the downhill side to collapse. We rarely have to slow down, though, because there's almost no other traffic. Sometimes these bus-size chasms are marked with branches piled in the road, and sometimes they're not.

"The contractor gives a kickback to the government to get the paving contract, and then they purposely do a bad job so they can come back in a few years for repair work and everybody can make more money," one of my companions says. By now I've heard stories like this so often that they seem normal.

After crossing a bridge over the Telen River, we stop near a roadside house that barely qualifies for the name. It's an open-air wooden platform no more than ten feet square, elevated on logs head-high off the ground. The roof is a sheet of blue plastic suspended from poles. A woman and two children are on the platform and three more children are playing underneath.

Felled tree trunks are scattered across a field beyond the house; the ground is blackened from recent burning, and smoke rises here and there. Several men and women work in the field with machetes and long digging sticks made of *belian*, or ironwood. This is forest destruction and habitat loss happening before my eyes.

Two men come over to talk with us—Udan Usat and Ismael, uncle and nephew. They wear Javanese-style conical straw hats against the intense sun. Their faces and arms are coated with soot, and sweat makes small rivulets on their skin.

They are of the Kenyah tribe, and they moved here last year. Before, they lived in a village called Long Noran on the Wahau River, in the interior of Borneo. The forest there is long gone, cut by a big timber company once owned by the notorious Bob Hasan, a Suharto crony and former government minister who was later convicted of corruption. With only scrub left, the entire area around their village, which stood inside the company's timber concession, burned in massive fires in 1997-98. The blazes were ignited by companies preparing land for plantations and spread rapidly to neighboring land during a season of drought.

"We had gardens, fruit trees, rubber trees, and vegetable fields, all burned," Udan Usat says. "There was conflict with the timber company. They accused us of starting the fires, but we didn't do it. The fires came from far away."

Things were very hard after that. "Where we lived it was an hour by boat and 15 kilometers by land to reach the nearest settlement with a market," he says. "It was expensive to use the boat."

The government promised that each family could have five hectares, about 12 acres, along the road here, if they wanted to move. Some of the villagers came to look at the land, there was a meeting, and 169 families decided to start over again at this place.

"Here, we are between two towns, so it will be easier to sell our crops when the fields begin producing," Ismael says. Neighboring families are helping each other, working on a different plot each day. They will grow rice, bananas, and the spiny red fruit called rambutan. The

Raw scribblings of access roads and terra[illegible] fields erase the lush diversity of Sarawak's rolling lowlands in favor of a single tree: the oil palm. The profitability of palm oil has sent the crop sprawling across some eight million acres of Borneo—an area roughly the size of Switzerland.

Orderly ranks of oil palms displace native plant and animal species in Sarawak. A staple in home cooking and processed food manufactured across the globe, palm oil is also in big demand for making biodiesel. But the environmental benefits of this "green" fuel may not be worth the costs

burning they've just done will help the fertility of the soil, and they hope to have their first crops next year. Families are living in temporary shelters for now, because it's more important to plant the fields than build permanent houses. Ismael was head of an elementary school in Long Noran, and someday, if there are enough children here on the Telen River, the families may build a school.

"Life will be better here—that is our hope," Ismael says.

I thank these men for talking with me, and wonder whether I should give them money for their time. My binoculars cost more than the two of them will make in an entire year. I turn to go, and one of the children, a girl about seven years old, is holding a plastic bag with two *ontok*, fried dough balls; and *lemper*, rice wrapped in coconut leaf—a gift of food for me. She hands me the bag, and her smile shatters my heart.

Despite the stupendous new skyscrapers erupting around Jakarta, despite the new cars clogging its streets, the essential fact influencing conservation in Borneo is the extreme poverty of most Indonesians, who occupy three-quarters of the island. Whatever strategies environmentalists pursue to save Borneo's biodiversity must first offer ways for its residents to improve their lives.

"Nothing is more important than hunger," says Albertus of the Pontianak-based group Green Borneo. "Funding agencies need to change their way of thinking about this. Better health, better education, better economic conditions—that will help protect the forest."

Even as she shows me West Kalimantan

Environmental scientist Dessy Ratnasari examines a bauxite mine in the Indonesian province of West Kalimantan. The Indonesian-born researcher investigates which mining companies stay within their legal concessions, and which ones don't.

ecosystems and economies wrecked by unsustainable logging, Dessy Ratnasari makes sure I know the benefits it brought. "Many people in West Kalimantan grew up on money from timber companies," she says. "I grew up on the multiplier effects, because my father had a small clothing store, and the money people spent there came from timber. That is why I was able to go to school and get an education."

***Hati-hati* is one** of the few phrases of Indonesian I've learned. It means "be careful," as on the signs along this bumpy dirt road reading "Hati-Hati Logging." It's a hot morning in East Kalimantan, and I'm riding in a truck with Erik Meijaard, a Dutch conservation scientist associated with the Nature Conservancy who has worked in Borneo for 15 years, and his colleague Nardiyono. We've passed through miles of scrubland, and the landscape shows no sign of changing anytime soon. Once lowland rain forest, this area was clear-cut and never reforested. In the fires of 1997-98, it was part of the estimated 6.5 million acres of forest that burned in East Kalimantan. Now it is only bushes, small trees, ferns, and grass, overrun with vines. I stare at the passing scene, thinking that, if nothing else, the government responsible for allowing this is guilty of criminal negligence.

"It's sad, isn't it?" Meijaard says, reading my thoughts. "And yet," he continues, "this is the kind of forest where Nardi and I find some of our highest concentrations of orangutans." By "find" he means they have counted the nests that orangutans make each night or discovered other signs indicating the animals' presence. Orangutans are the most solitary of the great apes, difficult to spot even where they exist in good numbers. Meijaard has already told me that he has actually seen only two wild orangutans in the past two and a half years of regular fieldwork.

The truck crests a low rise in the road and—I almost feel I should interject here *I am not making this up*—there's a dark reddish-brown form in the road ahead. I see it, but my mind seems to stall. Midday…worthless scrubland …animal in the road…What? Gibbon?

"Orangutan!" Erik and Nardi shout in unison. The truck skids to a stop, and we all jump out as the orangutan retreats into the low woods beside the road. I follow it with my binoculars as it scuttles away, stopping repeatedly to look back at us, until it moves downslope out of sight.

The normally taciturn Nardi is beside himself. "You are so lucky!" he says, over and over. "An orangutan, right in the road!" Expletives and superlatives abound. Visitors to Borneo rarely see a wild orangutan; most see the semi-tame animals at well-known rehabilitation centers such as Sepilok in Sabah or Tanjung Puting National Park in Central Kalimantan.

There's more to this incident, though, than simply my winning-the-Powerball good fortune. What I've just seen symbolizes one of the most important issues for Borneo's biodiversity—and a tenuous hope for preserving it.

"The logged forest is the future for wildlife in Borneo," says Siew Te Wong, who works

Logs roll into this Malaysian plywood mill, but it's a slim harvest. Most of the older, larger trees are long gone. Looking elsewhere to fill demand, many Malaysian mills process illegal timber from Indonesia, where corrupt officials take payoffs from loggers—turning a blind eye to personal money moles.

Land-use practices in Indonesia make it the third highest emitter of

on conservation of the threatened sun bear.

"In Borneo, species do not go extinct over a broad area as a result of one round of logging, or even two and possibly three," says Junaidi Payne of WWF's Sabah office. "The balance of species changes enormously, but even the specialist birds or orchids or epiphytes are still there if you look in little valleys and the wet areas. So you can log forests and still save that biodiversity. But the thing you can't do is convert the whole thing to monoculture plantations," such as oil palm. "Then of course you lose everything. It's a biological desert."

WWF geographer Raymond Alfred shows me around Sabah's state-owned Ulu Segama Forest Reserve, where the forest has been thoroughly—and legally—logged, leaving woodland that seems downright puny compared with the skyscraping rain forest at nearby Danum Valley. Yet researchers have found Borneo's highest concentration of orangutans here, and the species is thriving in similar spots all around the island. Alfred and other Sabah conservationists managed to convince the government to save this degraded forest, once set for conversion to oil palm. A ten-year moratorium on logging has given them time to study the orangutans, and they hope to establish a lodge and attract some of the tourists who visit the nearby Kinabatangan River Sepilok rehabilitation center.

In East Kalimantan, Meijaard has spent much of his time in recent years working with logging companies to help them harvest trees sustainably, and with local villages to find ways for them to derive income from the forest. Purists may imagine the major conservation goal in Borneo to be the setting aside of vast tracts of untouched forest, but for biologists dealing with day-to-day reality, compromise is the only realistic alternative.

When Meijaard spends time in villages discussing the choice between forest conservation and oil palm plantations, he never mentions orangutans. "People get bored with that in five minutes. To them it's just another monkey in a tree that Western people want to come and look at. But if I talk to them about fish in the rivers or pigs in the forest, then they pay attention, because those are resources they can harvest from the forest."

Meijaard is unsentimental about timber harvesting and the sanctity of virgin rain forest. "Hey, it's the tropics. Plants will grow back," he says. "These forests have to earn their money somehow." Otherwise, they'll inevitably be turned into plantations of oil palm or pulpwood.

"You're trying to get people who have economic opportunities right now to forgo those benefits for other benefits years down the road," orangutan conservationist Paul Hartman says. "The bupati is in office for five years, and he says 'I'm going to make my money now.'"

Sustainable forest management—logging that provides income without compromising the long-term viability of the ecosystem, won't be an easy sell. In Sangatta, East Kalimantan, I talk with Daddy Ruhiyat, an adviser to the local government on conservation issues. "We have asked forestry companies to show us that forests can be as financially productive as oil palm," he says. "But nowadays there are no fresh ideas coming from the forestry sector to make land more productive. We have a choice of either good forest and no money, or cut down the forest for palm oil. There is a long list of companies asking for land for palm oil development."

Ruhiyat sees a role for forestry in his district, but primarily in plantations of fast-growing teak, which can be harvested every 15 years. "We want species that can be productive in a relatively short rotation," he says. "We have to grow forests in plantations. That is the only way."

I ask him how he feels about someone like me, from a country that cut its forests, mined its coal, depleted its wildlife, and became wealthy, coming to Borneo to question local people's decisions about conservation.

"It is reasonable that people in other countries are concerned about the Borneo environment," he says. "I'm not resentful of that. But the most important step is to make people have better incomes. It starts with oil palm

plantations, which bring money so people can enjoy better lives. It is hard for hungry people to appreciate nature."

Glen Reynolds of the Danum Valley Field Center says that "payment for environmental services" is the only thing that will tip the balance away from clear-cutting and palm plantations. He uses the broad term for finding ways to pay communities, regions, or countries to keep their ecosystems healthy and functioning. "Without that there's going to be no lowland forest left on Borneo in ten years," Reynolds says.

The 1997 Kyoto Protocol on reducing greenhouse gases to combat climate change controversially made no provision to pay for protection of existing forests—"avoided deforestation"—but the December 2007 multinational conference in Bali, Indonesia, took up the issue as it considered revisions to the Kyoto pact. A new acronym, REDD (Reducing Emissions from Deforestation and forest Degradation), came to the forefront of the climate-change debate, and conservationists in Borneo immediately saw it as perhaps the last, best hope for the future—offering the possibility of a framework for rich nations to combat climate change by paying for the preservation of significant tracts of tropical rain forest. An array of daunting problems stand in the way of REDD implementation, but for people watching Borneo's forest disappear, it's a chance.

"REDD, I would argue, is the one big prospect on the horizon," Frances Seymour of CIFOR says. "Let's be clear here: Why do people cut down trees? For the money. If you can give people the opportunity to make the same amount of money or more by leaving the trees standing, there's your answer."

In the end, conservation in Borneo is not about the beauty of the rain forest, or about orangutans, or elephants, or even oil palm. Not one conservationist I spoke with believed oil palm was intrinsically evil, and most agreed that a properly managed industry can benefit poor people without sacrificing Borneo's biological riches. Anne Casson, co-founder of the environmental group SEKALA, speaks for most when she says, "I don't think anyone's saying you can't have any more oil palm. It's just, where does it go? It can go onto degraded land rather than forested land. Until now, oil palm permits have been allocated in an ad hoc manner, regardless of environmental concerns. This can change if there is sufficient political will and good spatial planning."

But it all comes down to one thing. "It's about money," Casson says. "Money, money, money."

Here is another dream. Along a dirt road in southern Borneo stands a one-room wooden house, with a few banana trees in the yard and a small vegetable garden in back. Beside the house a man kneels, washing a Yamaha Jupiter Z motorbike. It's red, and it shines in the hot sun as the man rinses off the soap.

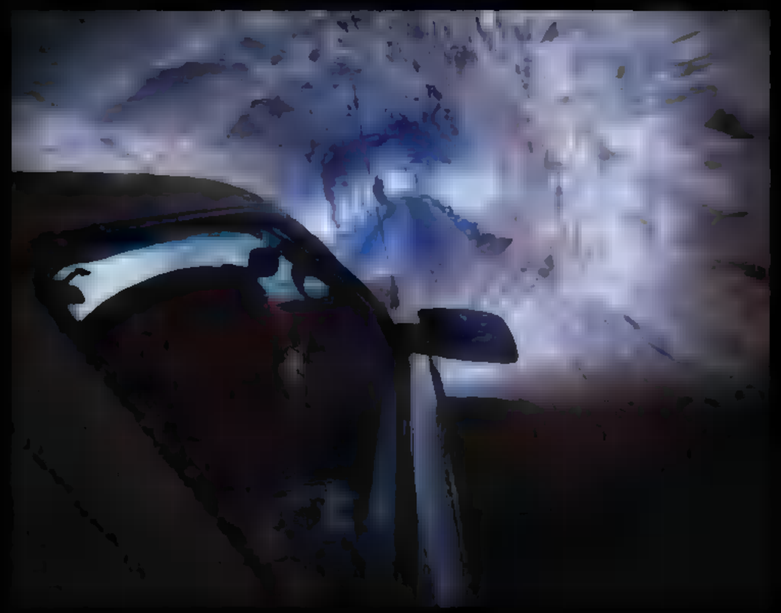
The man's name is, let's say, Pak Wang. With his new motorbike he can go to the closest village in a few minutes, instead of walking nearly an hour along the road. In the village he can meet his friends, buy things, go to the little karaoke bar, and watch television in his uncle's restaurant. He can feel part of the world.

Pak Wang wants a mobile phone. Most of his friends have one, and if he had one it would be easier for him to make plans with them, to know where they will be on Sunday night, to meet the pretty woman named Unita who sells fruit at a street stand in town.

So. Here is the message to the world. If we want to protect the forests of Borneo, to preserve a substantial part of its stupendous biodiversity, to make sure that orangutans have places to make their nightly nests and hornbills have fruit to eat and flying frogs have trees to live in, there's only one way to do it. We need to find a way for Pak Wang to buy his mobile phone. And, after he marries the pretty fruit-seller, a way for them to keep their children healthy and send them to school. A way that offers them a better future without having to turn their forests into plantations of oil palm or the sterile pits of strip mines.

And we need to do it while there's still something left to protect. □


Mexico's Cave of Crystals, found below the Chihuahuan Desert, formed over millennia, these crystals are among the largest yet discovered on Earth.



crystal palace

CAVERS IN MEXICO CONFRONT EXTREME CONDITIONS AND FIND EXTRAORDINARY BEAUTY.

Headed nearly a thousand feet underground, researchers descend by truck through a serpentine mine shaft (far left), then slip on ice-cooled suits to enter the cave, where temperatures spike above 110°F.

BY NEIL SHEA
NATIONAL GEOGRAPHIC STAFF

PHOTOGRAPHS BY CARSTEN PETER, SPELEORESEARCH & FILMS

In a nearly empty cantina in a dark desert town, the short, drunk man makes his pitch. Beside him on the billiards table sits a chunk of rock the size of home plate. Dozens of purple and white crystals push up from it like shards of glass. "Yours for $300," he says. "No? One hundred. A steal!" The three or four other patrons glance past their beers, thinking it over: Should they offer their crystals too? Rock dust on the green felt, cowboy ballads on the jukebox. Above the bar, a sign reads, "Happy Hour: 8 a.m. to 9 p.m."

This remote part of northern Mexico, an hour or so south of Chihuahua, is famous for crystals, and paychecks at the local lead and silver mine, where almost everyone works, are meager enough to inspire a black market. "Thirty dollars." He leans in. "Ten." It's hard to take him seriously. Earlier in the day, in a cave deep below the bar, I crawled among the world's largest crystals, a forest of them, broad and thick, some more than 30 feet long and half a million years old. So clear, so luminous, they seemed extraterrestrial. They make the chunk on the pool table seem dull as a paperweight.

Nothing compares with the giants found in Cueva de los Cristales, or Cave of Crystals. The limestone cavern and its glittering beams were discovered in 2000 by a pair of brothers drilling nearly a thousand feet below ground in the Naica mine, one of Mexico's most productive, yielding tons of lead and silver each year. The

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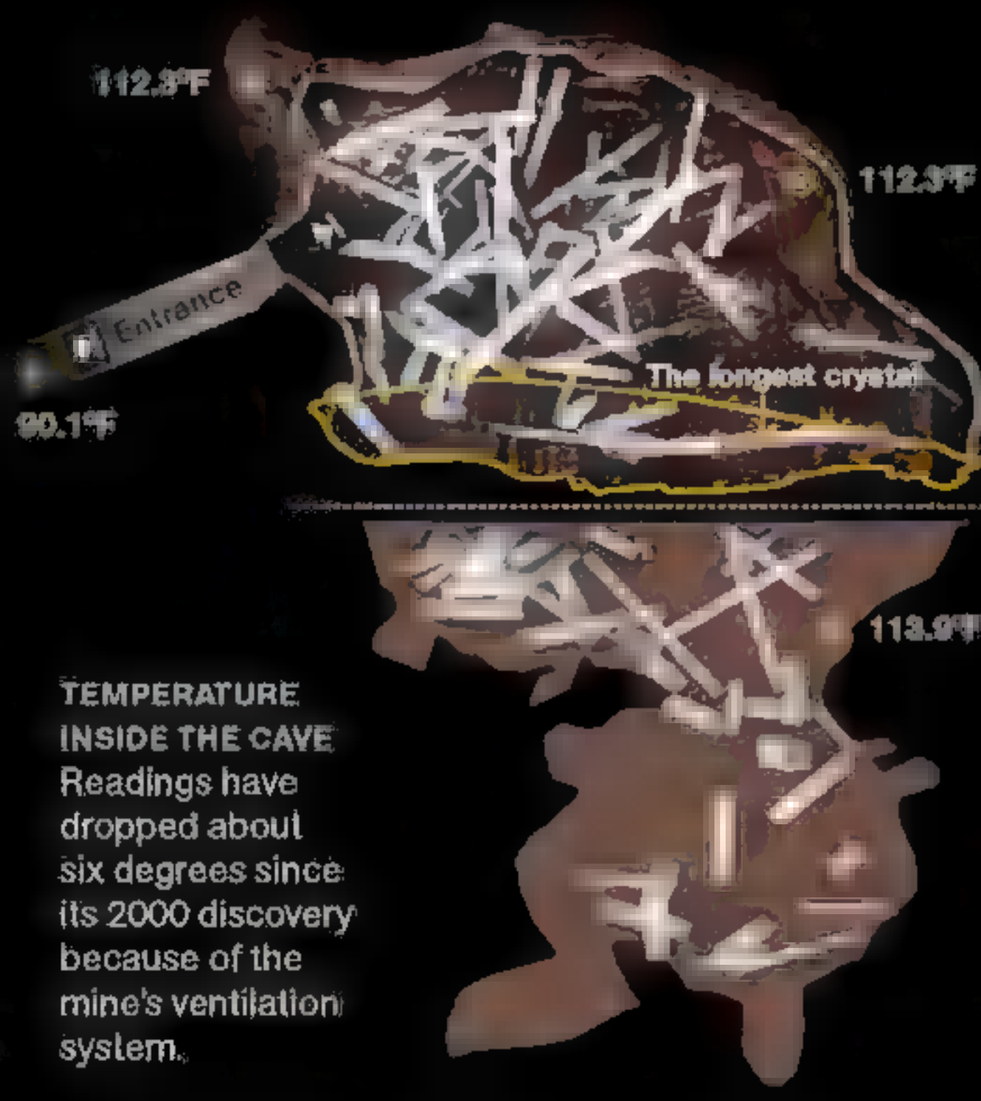
Carsten Peter specializes in photographing places inhospitable to humans—and cameras. He long ago lost count of how many he has ruined doing his job.

Chewing out space for cables and pipes, workers toil in the Naica mine, where excavations in 2000 led to the chance discovery of the giant crystals. Several other chambers bearing smaller crystals have been found in Naica, Mexico's most productive lead mine.

The Cave of Crystals

For more than half a million years, mineral-rich water filtered through this cavern under Naica Mountain, depositing molecules of calcium sulfate in orderly stacks. Heated by magma deep below and insulated by thick walls, the watery womb remained virtually unchanged, allowing crystals to grow to immense proportions.



TOP VIEW OF THE CAVE

Giant crystal

Door

Temperature reading

0 feet 35
0 meters 10

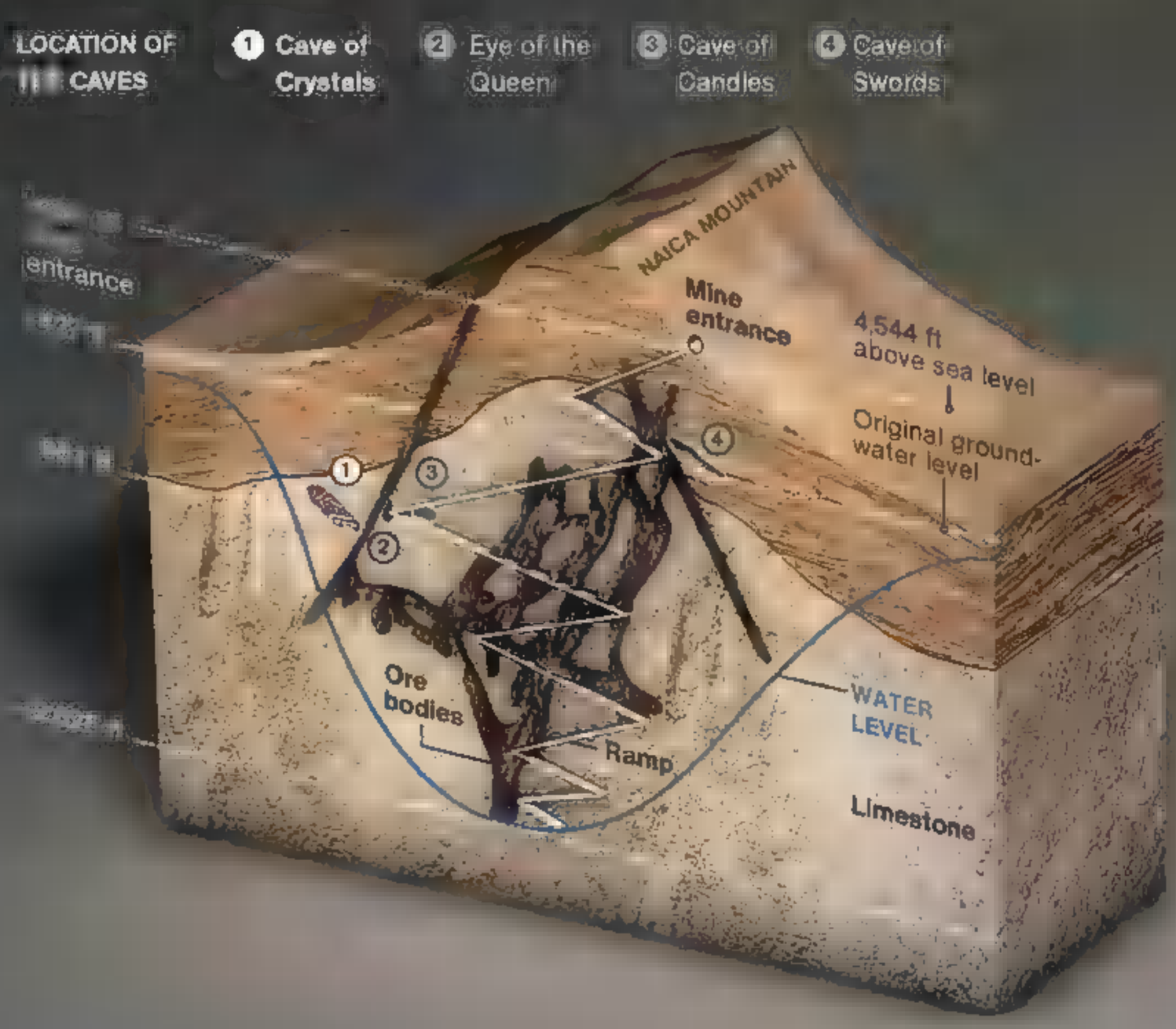
Cross section

ENLARGED VIEW

TEMPERATURE INSIDE THE CAVE
Readings have dropped about six degrees since its 2000 discovery because of the mine's ventilation system.

THE NAICA MINE

Veined with ore deposits rich in lead and silver, the Naica mine would flood if the water were not lowered by constant pumping. The action also drained the Cave of Crystals. The mine holds similar caves with smaller crystals, named for the shape of their formations: Cave of Swords, Cave of Candles, and Eye of the Queen.



NUMBER OF GIANT CRYSTALS
149 documented, with an estimated total of 170

THE LONGEST CRYSTAL
37.4 feet

TO SCALE

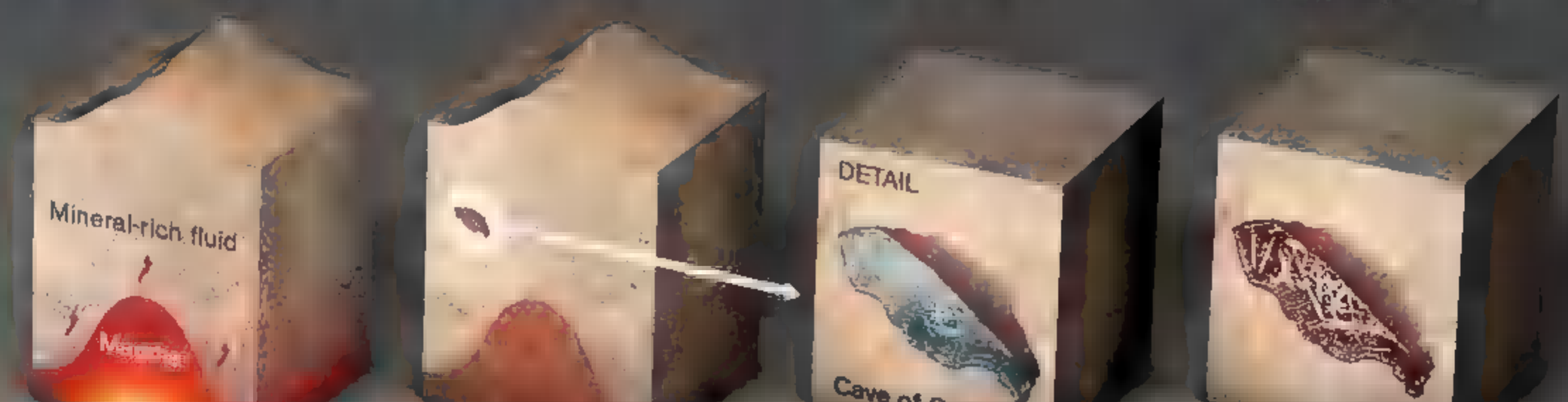
HOW THE MEGACRYSTALS FORMED

[illegible] million years ago
Volcanic activity pushes magma toward the surface. Intrusions of mineral-rich fluid [illegible] transformed into ore bodies and minerals that later form the crystals.

1-2 million years ago
Temperatures underground decline and caves form, filled [illegible] mineral-rich water. Anhydrite, a type of calcium sulfate, begins to dissolve into [illegible] cave water.

600,000 years ago
The cave cools [illegible] roughly 136°F, the right temperature for calcium sulfate in the water to form selenite crystals. Undisturbed, [illegible] becomes a nursery for giants.

ca 1985
Miners unknowingly drain the cave as they lower the water table [illegible] the mine with pumps. No longer immersed [illegible] water, the crystals stop growing.

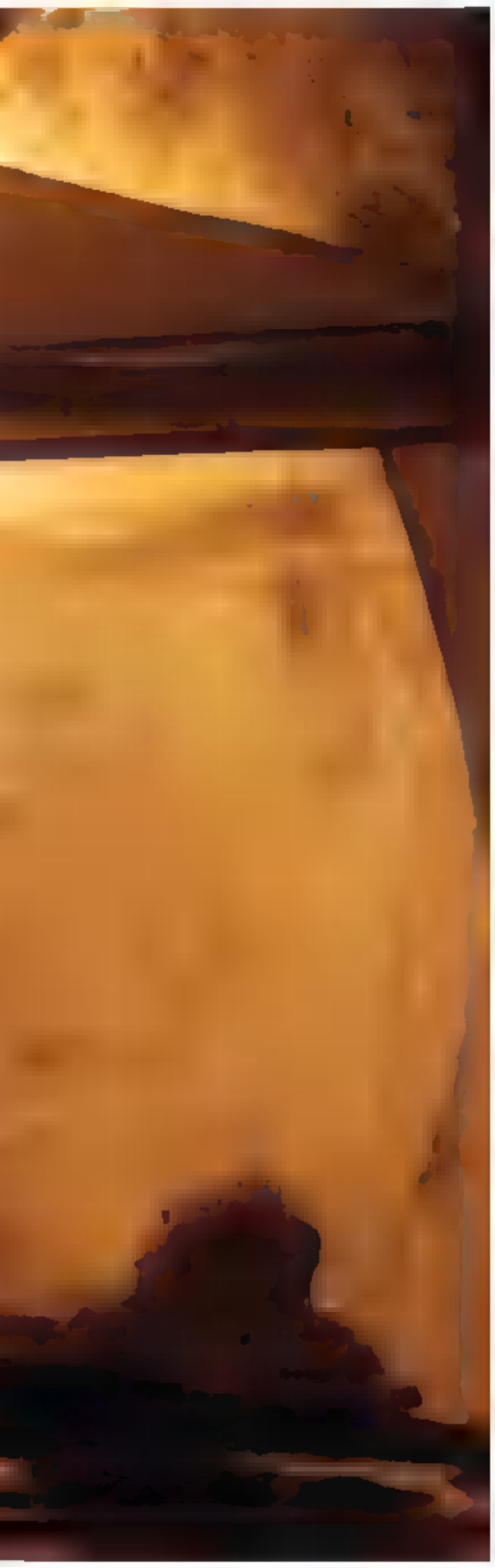


[illegible]

brothers were astonished by their find, but it was not without precedent. The geologic processes that create lead and silver also provide raw materials for crystals, and at Naica, miners had hammered into chambers of impressive, though much smaller, crystals before. But as news spread of the massive crystals' discovery, the question confronting scientists became: How did they grow so big?

It takes 20 minutes to get to the cave entrance by van through a winding mine shaft. A screen drops from the van's ceiling and Michael Jackson videos play, ■ feature designed to entertain visitors as they descend into darkness and heat. In many caves and mines the temperature remains constant and cool, but the Naica mine gets hotter with depth because it lies above an intrusion of magma about a mile below the surface. Within the cave itself, the temperature leaps to 112 degrees Fahrenheit with 90 to 100 percent humidity—hot enough that each visit carries the risk of heatstroke. By the time we reach the entrance, everyone glistens with sweat.

Preparing to enter the cave is like gearing up for ■ space walk. I pull on a vest with more than ■ dozen palm-size ice packs sewn into pockets across the chest and back. Then another vest to insulate the ice against the heat. Then, over everything, a bright orange caving suit. A helmet, a headlamp, a respirator mask blowing ice-cooled



Suffering is the price of admission where extreme temperatures mean cavers tire easily and risk potentially lethal heatstroke. Dr. Giuseppe Giovine (above, in helmet) of the Italian exploration team La Venta checks vital signs after one trip, most of which last no more than 20 minutes. Beyond Giovine's station, an air-conditioned tent (left) offers heat-sapped explorers some relief.

air. Gloves, boots. Even for cavers cocooned in all this protective gear, the heat is exhausting and dangerous; most trips inside last no more than 20 minutes. Giovanni Badino, a physicist from the Italian exploration group La Venta, leads us in.

Fallen obelisks, pillars of light, the crystals are enormous, some several feet thick. On the floor and walls are clumps of smaller crystals, sharp as blades and flawlessly transparent. Badino proceeds slowly, careful not to damage the crystals, which are made of selenite, a form of the common mineral gypsum. Selenite is translucent and soft, easily scratched by boot heels, even fingernails. Despite the ice suits, the heat and humidity are oppressive. I remove the mask for a moment and suck in wet, hot air. My lungs want to refuse it. There is a damp, heavy scent of earth and an absolute stillness. Miserable conditions for humans, a perfect nursery for crystals.

In their architecture crystals embody law and order, stacks of molecules assembled according to rigid rules. But crystals also reflect their environment. Spanish crystallographer Juan Manuel García-Ruiz was one of the first to study the Naica crystals beginning in 2001. More familiar with microscopic crystals, García was dizzied by the proportions of the Naica giants. By examining bubbles of liquid trapped inside the crystals, García and his colleagues pieced together the story of the

Perfect at least for now, luminous crystals face threats from foot traffic, looters, and condensation. Mine owners limit access to the cave, but researchers hope for legal protection.

crystals' growth. For hundreds of thousands of years, groundwater saturated with calcium sulfate filtered through the many caves at Naica, warmed by heat from the magma below. As the magma cooled, water temperature inside the cave eventually stabilized at about 136°F. At this temperature minerals in the water began converting to selenite, molecules of which were laid down like tiny bricks to form crystals. In other caves under the mountain, the temperature fluctuated or the environment was somehow disturbed, resulting in different and smaller crystals. But inside the Cave of Crystals, conditions remained unchanged for millennia. Above ground, volcanoes exploded and ice sheets pulverized the continents. Human generations came and went. Below, enwombed in silence and near complete stasis, the crystals steadily grew. Only around 1985, when miners using massive pumps lowered the water table and unknowingly drained the cave, did the process of accretion stop.

In the presence of such beauty and strangeness, people cast around for familiar metaphors. Staring at the crystals, García decided the cavern reminded him of a cathedral; he called it the Sistine Chapel of crystals. In both cathedrals and crystals there's a sense of permanence and tranquillity that transcends the buzz of surface life. In both there is the suggestion of worlds beyond us.

Now, in the cave, a team of scientists and explorers is conducting research and working on a documentary. Stein-Erik Lauritzen, a professor of geology at the University of Bergen in Norway, is retrieving samples for uranium-thorium dating. His preliminary research suggests the largest of the crystals are about 600,000 years old. Penelope Boston, an associate professor of cave and karst science at New Mexico Tech, searches for microbes that might live among the crystals. In some of them, tiny bubbles of suspended fluid—the kind García studied—sparkle in our lights. They are little time capsules: Italian scientists led by Anna Maria Mercuri extracted pollen that may have been trapped within these inclusions. The grains appear to be 30,000 years old and suggest that this part of Mexico was once covered not by desert but by forest.

One long, slender beam bears a deep scar from where someone tried to cut through it. I imagine a miner dripping and alone in the smothering silence, his weak headlamp bouncing with each saw stroke. Collectors might pay tens of thousands of dollars for a crystal from this cave. Whoever he was, he quit before he could sever the crystal, and mine owners later installed a heavy steel door to deter looters. So far it has worked, but who knows if it will last. Miners, after all, have access to drills and explosives. And while mining and construction projects can be halted to save archaeological relics, minerals in Mexico have no such protection.

The crystals could also be threatened by the lack of water. When the cave was filled, water helped support and preserve the beams. Now, with the cave empty and open to air, they may over time bend or crack under their own weight and become dull, as gases such as carbon dioxide wash in. The director of the mine told me his company, Peñoles, is dedicated to preserving them, but the company's main interest isn't crystals, and the basic activities of mining—blasting, trucks stirring up dust—threaten the gallery. Badino and others hope to convince the company to do more (lobbying for UNESCO World Heritage status has been mentioned), but so far the crystals exist in limbo, probably more famous outside Mexico than within.

We stop for a moment to rest. Everything around us glitters; it is as though we are standing inside a star. Badino turns, and the lines crease at the corners of his eyes. He pulls his mask away. "You know," he says, smiling, "there would be worse places to die."

Cathedral, star, tomb. We look for something to anchor the otherworldly in the familiar. After half an hour we depart, soaked in sweat, our veins throbbing, and a visiting filmmaker asks what it was like. I have a little trouble. He nods, understanding.

"Es como un sueño de niño," he says. "It is like a child's dream." □

THE TARAHUMARA OF MEXICO EVADED SPANISH CONQUERORS IN THE SIXTEENTH CENTURY. BUT CAN THEY SURVIVE THE ONSLAUGHT OF MODERNITY?

A PEOPLE APART


FUJIFILM PRO160S 51341

Costumed for pre-Easter rituals that merge ancestral beliefs with Christianity, members of the remote community of Choguita prepare for their roles as Pharisees. Three days of dancing and a symbolic battle between good and evil will end with Judas, the traitor, burned in effigy. Preceding page: In the village of Guagüeyvo, ten-year-old Leticia Mancinas García shows off the flamboyant colors and flounces of holiday fashion.

families into tiny Guaguieyvo
from secluded homes in the
Sierra Madre. Some 106,000
Tarahumara live in Mexico
most scattered among a
rugged, empty landscape.

BY CYNTHIA GORNEY
NATIONAL GEOGRAPHIC CONTRIBUTING WRITER
PHOTOGRAPHS BY ROBB KENDRICK

EACH STAR IN THE NIGHT SKY

is a Tarahumara Indian whose souls—men have three and women have four, as they are the producers of new life—have all, finally, been extinguished. These are things anthropologists and resident priests tell you about the beliefs of the Tarahumara people, who call themselves the Rarámuri, and who live in and above the canyons of northern Mexico's Sierra Madre Occidental, where they retreated five centuries ago from invading Spaniards. The Spaniards had not only firearms and horses but also disturbing beard hair; from their presence came the Rarámuri word *chabochi*, which to this day means anyone who is not Tarahumara. Chabochi is not an insult, exactly, just a way of dividing the world. Its literal translation, which goes a long way toward evoking the current relationship between the Tarahumara and the rest of 21st-century Mexico, is "person with spider-webbing across the face."

The Tarahumara are reticent and private people who live long distances from each other, in small adobe or wood houses, or caves, or homes partway under outcroppings so that the rock itself provides the roofing. They brew an alcoholic beverage from corn, which they grow in small fields they plow by hand, and on celebratory occasions they gather to pass the drink from person to person, taking swigs from a hollowed half gourd, until they become voluble or dreamy or belligerent and lie down on the ground to sleep it off. They are extraordinary endurance runners, having lived for generations amid a transportation network of narrow footpaths through the canyons; Rarámuri means "foot-runner" or "he who walks well," and they've been known to irritate American ultramarathoners by beating them while wearing huarache sandals and stopping now and then for a smoke.

They regard work as necessary for survival but lacking intrinsic moral merit of its own, and secondary to spiritual obligations and other matters of the soul. Their traditional economy is conducted by means of barter, not cash; they have a word for sharing that doesn't translate directly into Spanish or English: *"kórima,"* a Tarahumara woman may say, opening her palm for what a chabochi would call charity. There will be no thank you for the proffered coin, though, as kórima implies the obligation to distribute wealth for the benefit of everyone.

They also eat a lot of Maruchan, the Japanese instant noodles that come in plastic-foam tubs. Foil-wrapped potato chips, too, and plastic liters

A faithful farmer, Martín Bautista Jesús has come into Cusárare with his wife, Diana, for an ancient spring farming ritual. The couple may do some shopping, too, before heading home—most likely by hitchhiking. If they're lucky, they'll get a ride in the open trunk of a car traveling down a dirt road toward their distant ranch.

of Coca-Cola, and Tecate beer in pop-top cans—you can spend six hours rattling in a four-wheel-drive pickup toward the deepest remove of a Tarahumara canyon, hairpinning around crumbling dirt roads hacked straight out of the cliffs, until the truck winds around the very last drop-off, and the sun is setting and the smoke is curling from distant chimneys and the sound of ceremonial drums is floating up from somewhere way below, and there along the footpaths are two empty soda bottles and a discarded tub of Maruchan. These are useful for holding the romantic chabochi imagination in check. By the most recent government count, 106,000 Tarahumara live in Mexico, making them one of the largest indigenous groups in North America; the majority still live in relative isolation in the area Mexico promotes as Copper Canyon, but both the place-name and the image of its inhabitants sketched by tourist outfits ("They live a simple life undisturbed by modern technologies," reads one online write-up) turn out to be fragments, understatements, misleading in the neatness of their packaging.

The Copper Canyon itself, for example, or Barranca del Cobre, is actually only one of a dozen massive canyons in this part of the Sierra Madre. Several of them are deeper than the Grand Canyon. And chabochi commerce, legal and illegal, is pushing hard into all of them. The narco industry is increasing its use of the canyons for marijuana and opium poppy cultivation, displacing Tarahumara families from their corn, bean, and squash fields. Government efforts to bring roads and schoolbooks into Tarahumara communities are also bringing cheap tequila, thugs with guns, and all the *chatarra,* as Mexicans call junk food, hardy enough to stack up in makeshift general stores with no electricity. Traditional Tarahumara men wear wide headbands and loin coverings that leave their legs bare even when it's freezing, but many more now wear blue jeans and cowboy hats, and pointy-toed boots in leather dyed to match their belts. Most Tarahumara women still wear multicolored head scarves and long skirts of flowery prints or deep-hued pleats or billowy pastels gathered into scallops like fancy window drapes. But some now wear blue jeans too.

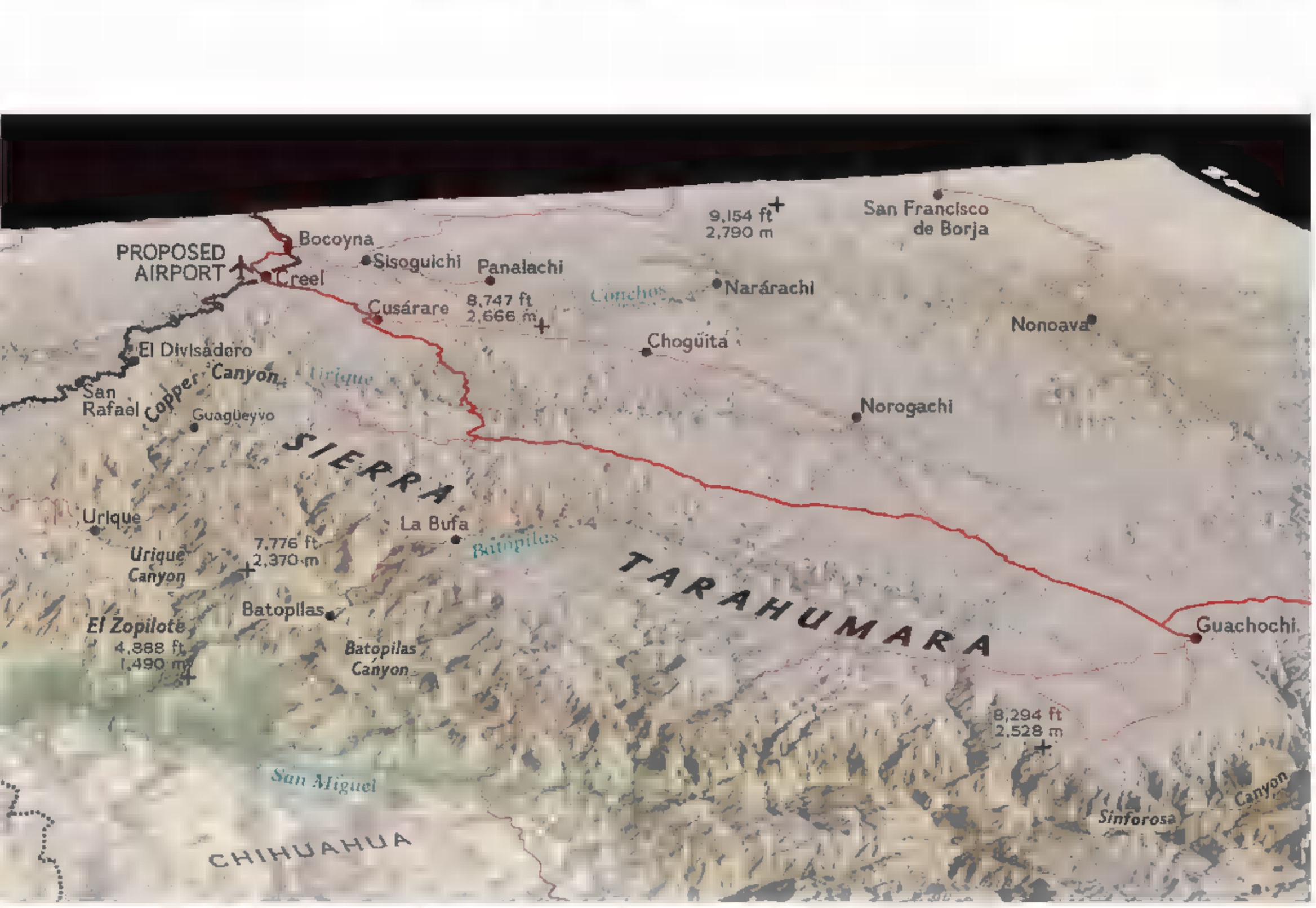
The region's first commercial airport is scheduled to be built in Creel, the former logging center whose present-day economy depends on

In the network of rugged canyons that cut through the mountainous state of Chihuahua in northern Mexico, the Tarahumara have lived as solitary subsistence farmers and herders since eluding Spanish conquerors in the 16th century. For generations, dizzying footpaths were the only routes between homesteads. Now roads are pushing in, bringing education and medical care along with junk food, drug dealers, and other modern problems.

the scenic railway line that runs through town. Government planners envision a subsequent hotel boom to accommodate eventual jetloads of new tourists. Officials in Chihuahua, the Mexican state encompassing most of the Tarahumara territory, are courting private investors for a proposed canyon-rim complex—bungee jumps, a chasm-spanning gondola, more hotels, and an "Indian village" for the permanent display of "rituals, ceremonies, and clothes"—to be built farther west on the railway route, along what's now a tourist overlook crowded with Tarahumara vendors. The vendors are nearly all women and children, offering the baskets and weavings they have learned tourists like. Girls not yet old enough for school, or old enough but nonetheless spending their days hawking souvenirs, hold up fistfuls of braided bracelets while repeating the first Spanish they ever learned: "*¿Compra?*—Want to buy?"

The Copper Canyon development plan is full of uncertainty and controversy—the airport construction has already been delayed many times, and environmental arguments continue, especially since the whole Sierra region suffers from periodic drought. (Promises of ecological sensitivity weren't going over well last spring, when everybody I met, including government officials, knew that one already existing hotel had for years been dumping its raw sewage into the nearest canyon; the owner, who insists septic repairs are under way, happens to be a former state tourism director.) But there's a wider, more universally familiar drama taking place throughout the Sierra Tarahumara, as the territory is also called. With or without the airport, modern Mexico is arriving, permeating an indigenous culture that managed for a long time to keep outsiders largely at bay. Every impulse to imagine that this makes things simple, though—a once harmonious native people, defiled by invaders with misguided notions of what it means to be civilized—is yanked away in short order by the people who actually live in the canyons.

THE CLINIC NURSE in the Sierra Madre town of San Rafael, a 35-year-old half-Tarahumara woman named Lorena Olivas Reyes, says her Tarahumara patients are sufficiently chabochified—that's the term in the



MARTIN GAMACHE AND LISA R. RITTER, NG STAFF

SOURCES: MEXICO NATIONAL INSTITUTE OF STATISTICS, GEOGRAPHY, AND INFORMATICS; ROBERT SCHMIDT

Sierra, *chabochiado*—that she doesn't have to invent a new Rarámuri construction for the phrase "high blood pressure," which does not exist in Rarámuri. She is able to use Spanish when she explains to her patients that they, like chabochis, are now suffering from *alta presión.* Lorena has high, sculpted cheekbones and thick waist-length black hair, which is wound into a tidy chignon while she's at work in San Rafael. Whenever I've seen her at the clinic, she's been in her nursing whites, looking regal and severe as she moves efficiently among the Tarahumara women in their glorious long skirts.

Lorena first migrated from the place where she grew up, a canyon-walled Tarahumara settlement called Guagüeyvo, when she was 13 years old. She climbed out, literally—there was no road then, and the exit trails head right up the canyon slope—because she loved learning, and the next available grades were in a school too many hours away for even a foot-runner child to navigate every day. I learned this the day Lorena and I convinced a San Rafael carpenter to drive us the five hours to Guagüeyvo in his pickup truck, along with Lorena's three sons, an old bicycle, a tub of lard, a wheel of cheese, a bag of foil-wrapped chocolates, and two rose plants for her mother's garden.

It was the Thursday of Semana Santa, or Holy Week, the pre-Easter days that mark the most sacred time of the Tarahumara year. Jesuit priests first brought Christianity to the Sierra Tarahumara during the 1600s, but they were thrown out a century later, when political tensions prompted the Spaniards to expel all Society of Jesus members from New Spain, and by the time the Jesuits returned in 1900, Tarahumara religious practice had morphed into an intensely held juxtaposition, Catholic liturgy combined with ancient faith, that prevails now in much of the Sierra Madre. Things happen in the canyons during Semana Santa that would startle most Christian outsiders coming upon them for the first time—there's a Judas-in-effigy part a newcomer might fret about allowing a small child to watch; and the Pharisees, the pious Jews of the biblical era, assume primary roles in a pageant of running, drumming, dancing, drinking, and battle. It makes for powerful spectacle, the men sometimes painting their faces and torsos in fierce pointillist arrangements of white against skin, and every spring the weeklong ceremonies attract thousands of visitors to the Sierra. They don't come to Guagüeyvo, though, as it's not even marked on some maps. The whole community is a scattering of dwellings around a brushy concave place in the cliffs, and inside Lorena's family's kitchen we sat around a long table at dusk, eating hot tortillas, which her mother, Fidencia, kept lifting off the stove top and dropping onto a plastic plate.

"How's it going with the dancing?" Lorena asked.

"The lead Pharisee fell and broke his leg," Fidencia said.

They were speaking in Spanish, which Fidencia learned in the Rarámuri elementary school, several hours' walk from the cave where she was born, during the years before she married Lorena's father, Catarino Olivas Mancinas. He is a miner's descendant, from a non-Tarahumara family that goes back a long way in the Sierra Madre. The house he keeps adding on to is among the nicest in Guagüeyvo: extra sleeping rooms with mattresses for the adult children and grandchildren who also live here, plus concrete floors, and a porch with pried-out automobile bench seats for sofas. There's a small solar panel too, which illuminates a couple of buzzing yellow lamps after dark; a road to Guagüeyvo was finally built three years ago, its dirt surface just wide enough for the delivery of electrical poles, but the poles aren't functional yet. Fidencia has been told electricity will come soon. When it does, Lorena will bring her a refrigerator.

This was something to contemplate, this refrigerator. I knew precisely what it would look like: black and shiny. It belongs to Lorena, and

at present it's in her kitchen in San Rafael, where there are a couple of paved streets, and most of the houses have electric hookups and flush toilets. It had been a year since Lorena and Fidencia had last seen each other, and although their reunion had been reserved—Fidencia lumbering toward her daughter and nodding and accepting a light embrace—Fidencia now stayed close by Lorena's side as the two of them patted out tortillas and tossed them on the stove. The corn for the tortillas was from the previous season's harvest. Fidencia had collected dried blue kernels that morning, soaked the corn in water from the storage tank outside, cranked the corn through the hand grinder on the porch, and smashed the grindings into meal on the stone metate, the one she brought from the family cave, the kind her grandmother had used, and her great-great-great-grandmother also. Then Fidencia had gone outside again, to haul in an armload from the woodpile and start a fire in the iron stove.

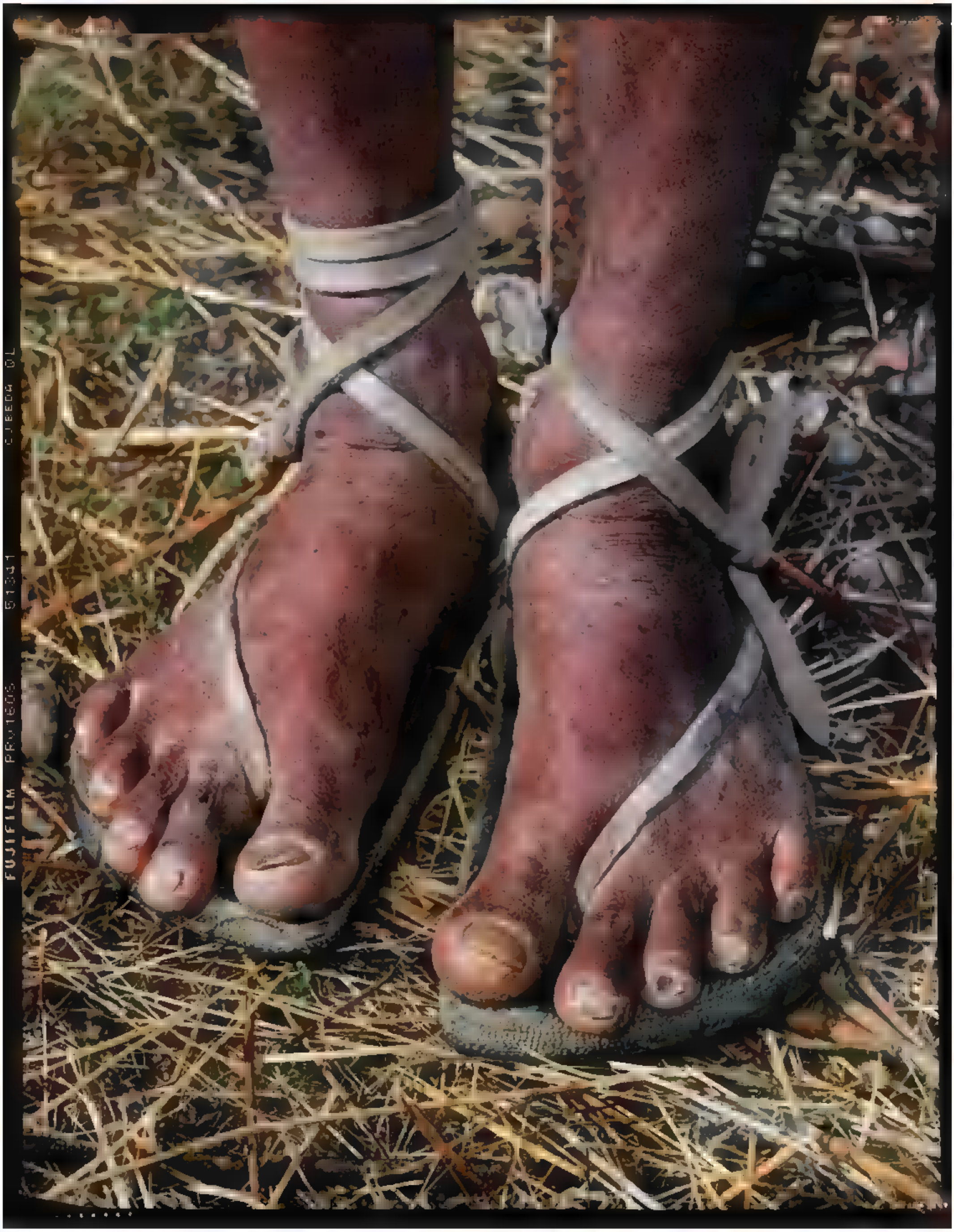
The tortillas were thick and tasted delicious. Fidencia had pulled a chicken from the coop that morning and beheaded it and de-feathered it and dismembered it with a knife before dropping it into the pot, so there was the aroma of simmering *caldo,* meat and vegetable soup. She was wearing a flowery rose-colored skirt, a bright blue sweatshirt, and a bandanna tied under her chin. Her arms looked as strong as a weight lifter's. ("You know how I get rid of being tired when I'm at work?" Lorena asked me later. "I say to myself, My mother is more tired than I am.") I had heard one of the Jesuits remark that the expanding network of truck-navigable roads was causing the Tarahumara to lose their walking and running endurance over long distances, and now with my mouth full of tortilla in the golden light of the stove fire, I found myself envisioning electricity in Guagüeyvo as a pileup of metallic chabochi objects with cords sticking out—push-button grinders, digital clocks, hair dryers, the new black refrigerator, TVs broadcasting *telenovelas* between commercials for mascara and laundry soap. I asked Fidencia how she would react, should somebody bring all these items into her home, and she stopped looking at her daughter long enough to take me in for a moment, gravely but kindly, as though she were trying to figure out whether I could possibly be as stupid as I appeared.

"That would be very good," she said.

When I glanced at Lorena, she was trying, with Tarahumara dignity, not to laugh.

THE CHOICE of the Sierra Madre as a strategic retreat from the Spaniards all those centuries ago is both the gift and the burden of the Tarahumara today. Their ancestors weren't cowards or pacifists; histories recount violent rebellions among Tarahumara in less remote mission and mining centers, where colonists used them for brute labor while trying to press them into European-style village living. But as a people, the Tarahumara survived largely because of what a Sierra priest described to me as a gift for the evasive maneuver—and here the priest clapped his right hand over his left and then slithered the left out gently from underneath, like a fish slipping through a crack in the rocks.

The geography that made the Tarahumara's lands so inaccessible to conquerors, though, made them irresistible to a succession of plunderers. The peaks and canyons contained silver and other minerals, which drew miners as early as the 17th century. The forests attracted loggers, who leveled the trees and eventually—under the initial leadership of a late 1800s American engineer—got a railway built to carry out the spoils. The construction effort lasted almost 80 years; the completed track that winds through the Sierra Madre, with its high bridges and multiple tunnels, is a marvel of railway engineering. These days the logs are brought out by truck (still in reckless numbers, logging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Keeping with custom, Francisco Rico Chávez wears a blanket to ward off December's chill in a portrait framed by the camera's ring light. Above him, on the wall of Panalachi's community center, hang a wooden bow and a raccoon quiver full of arrows. Occasional hunting has long contributed to a diet mainly based on corn, beans, and squash, but today the Tarahumara are turning more to convenient packaged foods. Famed for their endurance, they once pursued prey over long distances in bare feet, or in the simple sandals of their ancestors. Many still favor that footwear (left), now usually soled with a piece of old tire.

critics say, despite their admonitions about the degradation of the forest), and the principal train now using the Sierra track is called the Chihuahua Pacífico, or more familiarly, the Chepe. It's pronounced CHEH-peh, and its main job is hauling tourists.

Tarahumara and other locals ride the second-class Chepe regularly, en route to the towns or seasonal fruit-picking jobs just beyond the mountains. But the real Chepe money comes from outsiders, Mexican and foreign, who crane their necks out the railcar half-doors and disembark at the overlooks, where the first full view of the canyons is so astonishing, such a dizzying display—the Copper label isn't from the mineral, but rather from the luminous colors of the massive sunlit cliffs—that the next exploitable resource is obvious: grandeur. You're standing there blinking, taking it in, thinking: This is too beautiful. There are too many people with money who want a piece of this, including the entire development-hungry nation of Mexico. It's not a fair fight.

Scholars of the Tarahumara say their culture is remarkable in its tenacity—that for centuries they have sidestepped one form of chabochi interference after another, which is why the language remains vigorous, the religious beliefs intense, and so many women still wear the scarf and long skirt. Once I watched a women's race outside a grim-looking Rarámuri enclave in Chihuahua city, where thousands of Tarahumara have migrated to live in close-quartered ghettos that take up entire blocks. The Tarahumara do much of their running in a traditional form of Rarámuri competition, people gathering to bet livestock or other possessions on the outcome. The men race in staggeringly long trail runs, wearing huaraches or barefoot, while steadily kicking a baseball-size wooden sphere. When the women run, they fling and catch hoops with long sticks as they go, and that's how the girls and young women were running through the streets of Chihuahua, huaraches slapping the pavement, skirts flapping at their calves. Behind the cheering spectators, who looked to be their aunts and grandmothers, the wagered goods were heaped hip high: a mound of Rarámuri garments, brilliant as jockey silks.

But the mound was on a concrete sidewalk. Behind it, the warren of living quarters was as crowded as buildings I'd seen Tarahumara in the canyons use for sheltering goats. There are teachers and carpenters inside the tiny apartments of Rarámuri enclaves, and resident elders respectfully deferred to for community leadership, and university students majoring in anthropology or industrial engineering. But there are also narco workers, everybody knows that, and teenage boys slouched against the walls with their caps turned backward, and glue sniffers and beggars, and girls having babies at 13, and diabetes cases to go along with the junk-food obesity and the alta presión. These aren't entirely urban scourges, either; in Guagüeyvo I met a young chabochi doctor who kept a clinic wall chart of malnutrition cases in children under five—60 such cases as of this past spring, he told me, the combined consequence of poverty, depleted crops, and alcoholic parents too dulled by corn brew or trucked-in liquor to understand that their children are not getting enough to eat.

"The life of the Tarahumara has changed more in the last 20 years than in the previous 300," a Creel priest named Pedro Juan de Velasco Rivero told me. He is one of a group of Sierra-based Jesuits who serve as traveling clerics and Tarahumara-chabochi intermediaries—several speak excellent Rarámuri—and who are now among Mexico's most adamant critics of chabochi culture's effect upon the Tarahumara. Outside of the state tourism office it's hard to find anyone in Chihuahua who believes wholeheartedly in the Copper Canyon development blueprint, with its vast glass-and-steel canyon-rim scaffolding and its enthusiastic estimates of the size of the potential visitor market: 7.2 million from the

On his goatskin tambour Juan Daniel Reyes Moreno will beat out ancient rhythms around the clock to help bring the Easter festivities in Choguita to a crescendo. A bead centered on the single string vibrates with each percussion, creating a unique buzz. Three weeks before the holiday the haunting staccato from scores of drums begins to echo off canyon walls and metal roofs throughout Tarahumara territory.

U.S., one brochure declares in headline, another 5.5 million from Mexico. But I heard chabochis and even a few Tarahumara say the region could use this economic boost—some built-up tourist facilities and a local commercial airport. Poverty is not noble, one Creel hotel owner said heatedly, even when it lives in splendid canyons and dresses in beautiful skirts.

To which the priests reply: Jobs cleaning hotel rooms, with pretty paintings of Tarahumara on the lobby walls, are no advancement at all. "Don't pretend these are projects to help the Tarahumara," de Velasco said crisply. "They're to attract tourists and increase private profits. A 'Tarahumara village' is an absurdity—a lie, really. A gondola over the canyon would be a desecration. And this is an area without water; one new hotel will use more in a day than what a Tarahumara family consumes in a year. With what the government is preparing to invest for hotels, they could bring potable water to all the Tarahumara, which would be much more useful to them than creating a fake village where they can sell things."

AFTER DARK in Guagüeyvo, on the night before Good Friday, people began gathering outside the church, a half mile from Lorena's parents' house, across a fallow cornfield and a rocky stream gully. The drumming hadn't stopped; it would continue all night, off and on, and throughout the next 51 hours. Semana Santa rituals had been explained to me by anthropologists, by Tarahumara in other communities, by relatives in Fidencia's kitchen, and there wasn't much overlap in the explanations. The drumming, for example: It starts up three weeks before Semana Santa, all over the Sierra Madre, and a soft-voiced woman stirring lunch stew at a Rarámuri school had told me the sound keeps God from dozing off, because the devil comes nearest this time of the year.

When I tried this on Fidencia, she replied along the lines of, "Isn't that interesting," in a let's-humor-the-chabochi sort of way, and shrugged. We drum because it's time to drum, she said, sounding exactly like my grandmother trying to remember why a wine glass gets stomped on at the end of Jewish weddings. The Pharisees applying paint to their bodies; the costumed soldiers carrying decorated wooden swords; the shoulder-borne bowers containing Jesus and the Virgin; the straw effigy of Judas—startlingly shaped, one can't help but notice, to suggest the recent ingestion of a lot of Viagra—these are Semana Santa elements replicated all over the Sierra Madre, the crucifixion story superimposed upon planting-season ceremonies, good-over-evil catharsis, and a pre-Christian reverence for the rain, the sun, the moon.

In Guagüeyvo I made one delicate inquiry about Judas's anatomy, having waited for a moment when no men were present, and every woman in the room hooted with laughter. But nobody was sure about the answer, and a visiting nun said she gathered the intent was to make Judas look ridiculous. "Remember, he's a traitor," the nun said. "And he's about to be destroyed."

Now the moon was full as Lorena and I started out across the cornfield. I had put on a skirt and tied a bandanna over my hair, wanting to appear respectful, and Lorena, who was in the corduroy jeans she'd been wearing all day, looked at me reproachfully. "You dressed up," she said, and sighed. "Well, OK."

She went back into the house and came out wearing a skirt and scarf—but the scarf was wrapped as a headband, not tied under her chin. As we walked in the moonlight toward the churchyard, where Lorena's cousins were beating the goatskin drums and dancing in snaky lines, she shoved rocks out of the way with her athletic shoes. "I'm not putting on huaraches, though" she said. "I get too many stones under my feet."

It's so easy to absorb this in a certain way, the mixed-heritage woman in battle with her own

identity, and so on. But Lorena's father was in the churchyard already, playing a Tarahumara wood flute with his eyes closed as men with painted faces traced a slow skipping grapevine around him. He is a lean, dark-skinned man who had shaken my hand without comment when I arrived, fixed his gaze on me for a time, and then said abruptly, "Where were you when the Twin Towers fell?" After he heard my answer (home, in California), he nodded, asked me whether Osama bin Laden had been located yet, and went back to playing his flute. He and his twin brother were helping direct the Semana Santa ceremonies. They belong to Guagüeyvo. Lorena does not, not anymore, because she wants for herself and her three young sons things the canyon's isolation and inadequate elementary school can't provide. After she began working as a nurse, she came home for five years, posted at the small medical facility the state had built beside the Guagüeyvo school. They offered to let her stay on. She elected not to. She no longer owns a Rarámuri skirt that fits.

"I *am* an indigenous woman," Lorena said to me late that night, as we sat up talking; we were grappling with the idea of identity, what it means to be of one culture or another, and how easy it is to muddle things: When do efforts to preserve an indigenous culture begin to trap individuals in some romantic notion of what that culture is supposed to be? Lorena has no enthusiasm for the Copper Canyon development plan; room-cleaning jobs are not what her people need, she said, and she feels a little queasy when she sees the Rarámuri handicraft sellers looking solemn and colorful while the tourists take their pictures. But her reasons are fundamentally unsentimental: They don't make enough money at it. They ought to charge more than they do. And their children ought to be in school. And they ought to stop teaching their sons how to drink.

A single candle was burning in the back room Lorena and I were sharing with two of her boys. It was past midnight. We could still hear the drums. "I feel so calm when I come here," Lorena whispered.

Then she said, suddenly, "I'm going to have a birthday party when my son turns six. I'll tell my sisters I want them to come. I want them to leave here. Maybe just for a few days. But I want them to see what it feels like in town." She meant her two unmarried sisters, both younger, both minimally schooled, living in the family house. The older of the two has three children already, but the children's father has another family in Guagüeyvo. "They could be bilingual nurses too, working in clinics," Lorena whispered. "There is nothing for them here."

JUDAS BURNED on Saturday morning. The vats of corn brew were dragged into the open, drinking began at first light, and hot pozole, corn stew made with a slaughtered goat and rabbits caught by Pharisees on the trail the day before, was dished from giant barrels outside a house up the canyon from Lorena's. ("I would walk with you on the trails this afternoon to homes you are unable to see from here," one of Lorena's cousins said courteously, handing me a dish of pozole and a gourd of the corn brew, "but I plan to be extremely drunk.") Then everybody tramped to the churchyard. The effigy was dragged to an open place, a black baseball cap on its head, and a half dozen drunk men fell upon it, shouting, kicking, ripping at the limbs. Finally someone put a match to Judas, and when there was nothing left but ashes and charred bits of straw, the drunk men stood back unsteadily, breathing hard.

Someone cried, *"¿Ahora qué hacemos?"*

Lorena broke up laughing. She shot me a look. She squeezed her five-year-old's shoulders and repeated this, loudly. *"¿Ahora qué hacemos?*—What do we do next?"

Cynthia Gorney reported on Mexico's southern border in the February issue. Photographer Robb Kendrick's latest book is Still, *about 21st-century cowboys.*

Sandwiched between countless
weathering rocks, a sloping cliff
forms the roof of Petra
Bedouin Smaloan home near
Wadi Mor. Her patio holds a
row of hand
and machine-made goods

Proper attire includes a head scarf for 80-year-old María Roselia Cobes Huelinachi, who weaves and sells baskets near the Copper Canyon overlook in El Divisadero—for now. A controversial development plan that aims to attract more tourists would relegate Tarahumara craft vendors to an artificial village. Modern life is already pushing aside the old ways in distant Chihuahua city, where 16-year-old Edgar Silverio Galeárra Rodríguez (left) was born and raised. Though his headband is common in his own culture, it also fits with the urban style he has adopted—a shirt showing rapper Eminem, a flashy necklace, and low-slung black jeans.


FUJIFILM PRO160S 51341

Still taking after their mothers, shy girls at a school in Panalachi wrap themselves in shawls rather than jackets when winter temperatures plunge. As they learn more about the outside world, though, they may make very different choices. □

OUR VANISHING NIGHT

A starry night gleams above Owachomo Bridge in Utah's Natural Bridges National Monument—named the first Dark Sky Park by the International Dark-Sky Association (IDA). "Here you see something forgotten," says ranger Scott Ryan, "and reconnect with the sky."

Chicago at night burns bright under blankets of clouds. Much of the glow escapes from streetlamps, including clear, Victorian-style lamps good for creating atmosphere but poor for harnessing today's extra-bright bulbs.

LIGHT SHOW

The electric blush of Salt Lake City, more than a hundred miles away, brushes the horizon over Utah's Bonneville Salt Flats (left). A more pointed source sits atop Las Vegas's Luxor Hotel (right), where curved mirrors focus 39 lamps into a single beam aimed into space. "I wouldn't fight to make Vegas dimmer," says IDA's Pete Strasser. "Just so such excess stays in Vegas."

BY VERLYN KLINKENBORG
PHOTOGRAPHS BY JIM RICHARDSON

If humans were truly at home under the light of the moon and stars, we would go in darkness happily, the midnight world as visible to us as it is to the vast number of nocturnal species on this planet. Instead, we are diurnal creatures, with eyes adapted to living in the sun's light. This is a basic evolutionary fact, even though most of us don't think of ourselves as diurnal beings any more than we think of ourselves as primates or mammals or Earthlings. Yet it's the only way to explain what we've done to the night: We've engineered it to receive us by filling it with light.

This kind of engineering is no different than damming a river. Its benefits come with consequences—called light pollution—whose effects scientists are only now beginning to study. Light pollution is largely the result of bad lighting design, which allows artificial light to shine outward and upward into the sky, where it's not wanted, instead of focusing it downward, where it is. Ill-designed lighting washes out the darkness of night and radically alters the light levels—and light rhythms—to which many forms of life, including ourselves, have adapted. Wherever human light spills into the natural world, some aspect of life—migration, reproduction, feeding—is affected.

For most of human history, the phrase "light pollution" would have made no sense. Imagine walking toward London on a moonlit night around 1800, when it was Earth's most populous city. Nearly a million people lived there, making do, as they always had, with candles and rushlights and torches and lanterns. Only a few houses were lit by gas, and there would be no public gaslights in the streets or squares for another seven years. From a few miles away, you would have been as likely to *smell* London as to see its dim collective glow.

Now most of humanity lives under intersecting domes of reflected, refracted light, of

scattering rays from overlit cities and suburbs, from light-flooded highways and factories. Nearly all of nighttime Europe is a nebula of light, as is most of the United States and all of Japan. In the south Atlantic the glow from a single fishing fleet—squid fishermen luring their prey with metal halide lamps—can be seen from space, burning brighter, in fact, than Buenos Aires or Rio de Janeiro.

In most cities the sky looks as though it has been emptied of stars, leaving behind a vacant haze that mirrors our fear of the dark and resembles the urban glow of dystopian science fiction. We've grown so used to this pervasive orange haze that the original glory of an unlit night—dark enough for the planet Venus to throw shadows on Earth—is wholly beyond our experience, beyond memory almost. And yet above the city's pale ceiling lies the rest of the universe, utterly undiminished by the light we waste—a bright shoal of stars and planets and galaxies, shining in seemingly infinite darkness.

We've lit up the night as if it were an unoccupied country, when nothing could be further from the truth. Among mammals alone, the number of nocturnal species is astonishing. Light is a powerful biological force, and on many species it acts as a magnet, a process being studied by researchers such as Travis Longcore and Catherine Rich, co-founders of the Los Angeles-based Urban Wildlands Group. The effect is so powerful that scientists speak of songbirds and seabirds being "captured" by searchlights on land or by the light from gas flares on marine oil platforms, circling and circling in the thousands until they drop. Migrating at night, birds are apt to collide with brightly lit tall buildings; immature birds on their first journey suffer disproportionately.

Insects, of course, cluster around streetlights, and feeding at those insect clusters is now ingrained in the lives of many bat species. In some Swiss valleys the European lesser horseshoe bat began to vanish after streetlights were installed, perhaps because those valleys were suddenly filled with light-feeding pipistrelle bats. Other nocturnal mammals—including desert rodents, fruit bats, opossums, and badgers—forage more cautiously under the permanent full moon of light pollution because they've become easier targets for predators.

Some birds—blackbirds and nightingales, among others—sing at unnatural hours in the presence of artificial light. Scientists have determined that long artificial days—and artificially short nights—induce early breeding in a wide range of birds. And because a longer day allows for longer feeding, it can also affect migration schedules. One population of Bewick's swans wintering in England put on fat more rapidly than usual, priming them to begin their Siberian migration early. The problem, of course, is that migration, like most other aspects of bird behavior, is a precisely timed biological behavior. Leaving early may mean arriving too soon for nesting conditions to be right.

Nesting sea turtles, which show a natural predisposition for dark beaches, find fewer and fewer of them to nest on. Their hatchlings, which gravitate toward the brighter, more reflective sea horizon, find themselves confused by artificial lighting behind the beach. In Florida alone, hatchling losses number in the hundreds of thousands every year. Frogs and toads living near brightly lit highways suffer nocturnal light levels that are as much as a million times brighter than normal, throwing nearly every aspect of their behavior out of joint, including their nighttime breeding choruses.

Of all the pollutions we face, light pollution is perhaps the most easily remedied. Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere and, often, immediate energy savings.

It was once thought that light pollution only affected astronomers, who need to see the night sky in all its glorious clarity. And, in fact, some of the earliest civic efforts to control light pollution—in Flagstaff, Arizona, half a century ago—were made to protect the view from Lowell Observatory, which sits high above that city. Flagstaff has tightened its regulations since then,

WHITE NIGHT

With 285 fixtures shining on 550 acres of runs, Oregon's Mount Hood Skibowl is the largest night ski area in the U.S.—drawing thousands of nine-to-fivers each season. Proper spotlighting is paramount on after-hours trails, but light falling on snow naturally bounces upward. Lower-lumen fixtures at some resorts have reduced the effect, but no design fully contains the glow.

and in 2001 it was declared the first International Dark Sky City. By now the effort to control light pollution has spread around the globe. More and more cities and even entire countries, such as the Czech Republic, have committed themselves to reducing unwanted glare.

Unlike astronomers, most of us may not need an undiminished view of the night sky for our work, but like most other creatures we do need darkness. Darkness is as essential to our biological welfare, to our internal clockwork, as light itself. The regular oscillation of waking and sleep in our lives—one of our circadian rhythms—is nothing less than a biological expression of the regular oscillation of light on Earth. So fundamental are these rhythms to our being that altering them is like altering gravity.

For the past century or so, we've been performing an open-ended experiment on ourselves, extending the day, shortening the night, and short-circuiting the human body's sensitive response to light. The consequences of our bright new world are more readily perceptible in less adaptable creatures living in the peripheral glow of our prosperity. But for humans, too, light pollution may take a biological toll. At least one new study has suggested a direct correlation between higher rates of breast cancer in women and the nighttime brightness of their neighborhoods.

In the end, humans are no less trapped by light pollution than the frogs in a pond near a brightly lit highway. Living in a glare of our own making, we have cut ourselves off from our evolutionary and cultural patrimony—the light of the stars and the rhythms of day and night. In a very real sense, light pollution causes us to lose sight of our true place in the universe, to forget the scale of our being, which is best measured against the dimensions of a deep night with the Milky Way—the edge of our galaxy—arching overhead.

Verlyn Klinkenborg lives under deep night skies in rural New York. Photographer Jim Richardson enjoys the dark skies at his home in rural Kansas.

Luminous patches glow on a map of nighttime Earth created from satellite and ground data on scattered light as of 1996-97. The situation is even worse today. Based on calculations, two-thirds of humanity lives under skies polluted with light, and one-fifth can no longer see the Milky Way. Least affected? The Central African Republic.

LIGHTING THE WORLD

In 1908 dark countryside surrounded Los Angeles and Pasadena, combined population 350,000, in view from Mount Wilson (right). In a 2008 view from a nearby vantage (far right), a mushrooming populace nearing five million fills the same valley, creating sea brightness.

 CARNEGIE OBSERVATORIES PHOTOGRAPH COLLECTION, HUNTINGTON LIBRARY (LEFT)

EXTENT OF DATA

Tokyo

NATURAL GAS FLARES

Mumbai (Bombay)

Bangkok

CENTRAL AFRICAN REPUBLIC

Johannesburg

Brighter night sky

Dimmer night sky

Area with sky glow

Dark sky areas

1,000 km

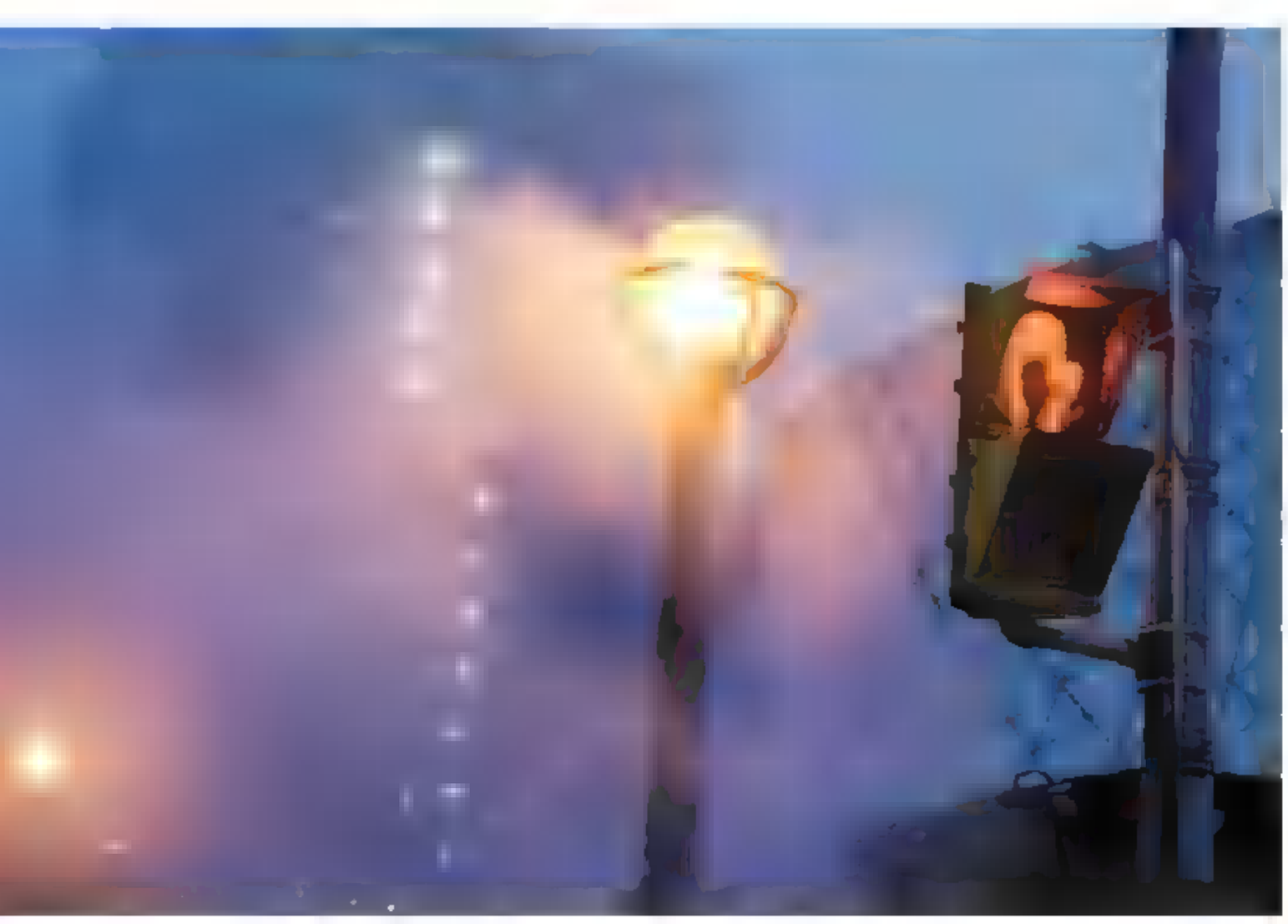
1,000

SEAN McNAUGHTON, M. BRODY DITTEMORE, AND LISA R. RITTER, NG STAFF

MAP DATA COURTESY LIGHT POLLUTION SCIENCE AND TECHNOLOGY INSTITUTE

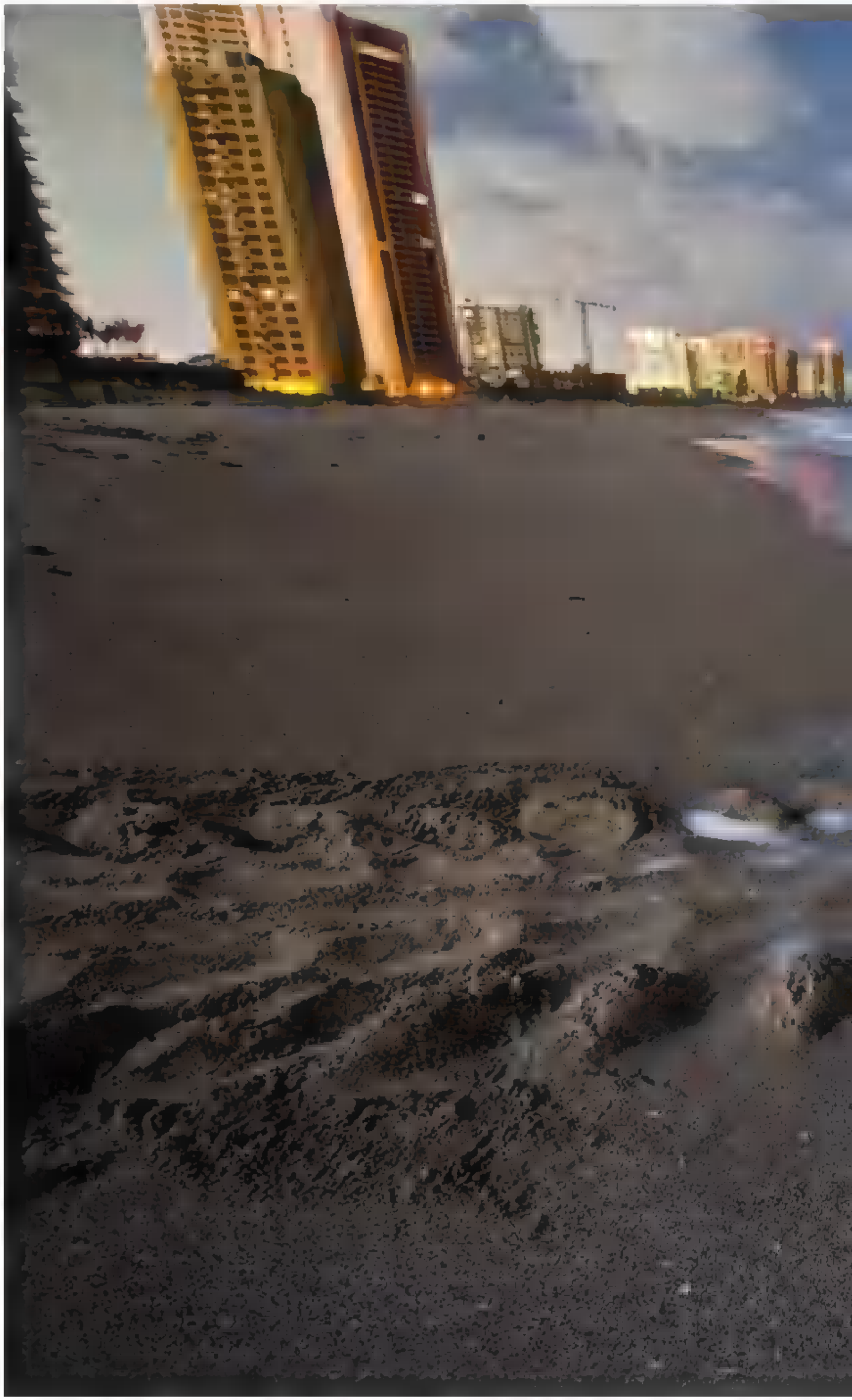
CUTTING THE GLARE

A globe-shaped fixture in Toronto's financial district (below) wastes much of its wattage over pedestrians' heads. Covered streetlamps in Harmony, Florida (right), spare the dark sky and save energy with their "full cutoff" design, which illuminates just the ground below. Bulbs are high-pressure sodium, giving a soft yellow glow. Porch lights tucked into ceilings keep light confined. "We see darkness as a natural resource that needs protection," says Greg Golgowski, conservation director of the Harmony Development Company. Others agree: Hundreds of U.S. communities now have ordinances requiring covered fixtures, light-density restrictions, and energy-saving light curfews.



OF ALL THE POLLUTIONS WE FACE, LIGHT POLLUTION
IS PERHAPS THE MOST EASILY REMEDIED

Forty-four xenon theatrical lights at its base give the stainless steel surface of the Gateway Arch in St Louis a dramatic night sheen against a ruddy sky. The beams are flipped off when fog dulls the effect or migrating birds pass through.

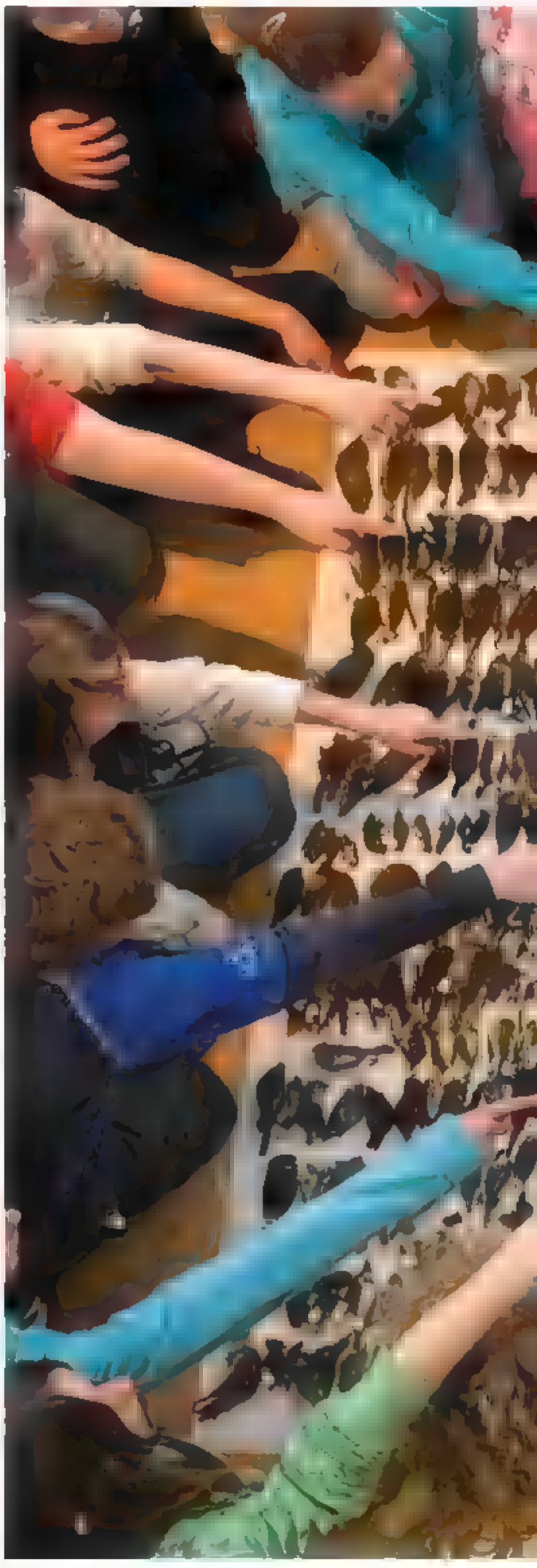


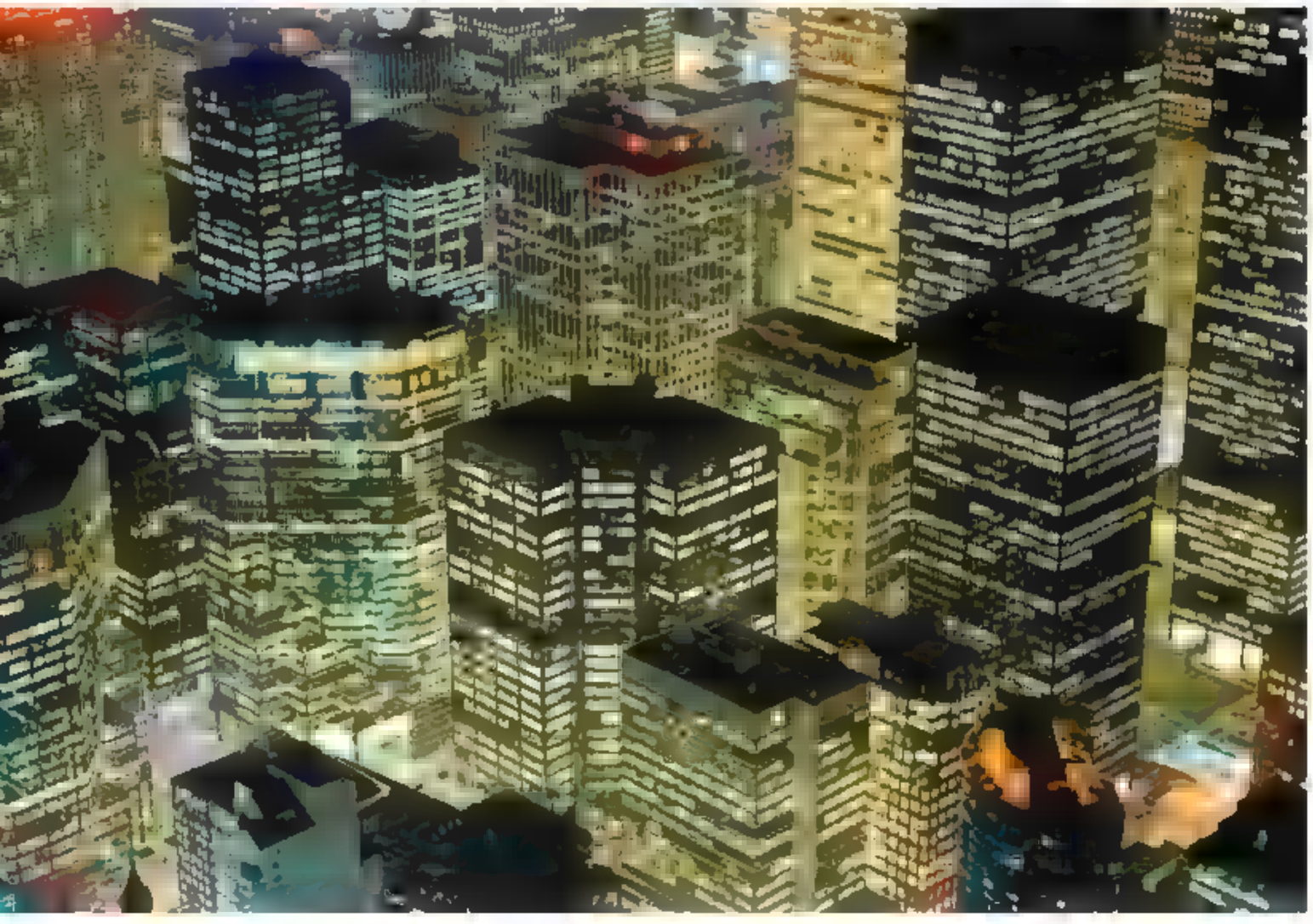
MIXED SIGNALS

Having laid her eggs, an endangered leatherback shuffles seaward on Florida's Singer Island. The horizon's natural glow helps guide turtles to water, but light from beach-front development can lead them off course. Strays, often hatchlings, can be hit by cars or snagged by predators.

BRIGHT MAZE

Artificial light from buildings confuses and traps birds, with deadly results. Avian victims (right) collected over three months in Toronto (below) and displayed for a school group at the Royal Ontario Museum total over 1,000 birds of 89 species. The Fatal Light Awareness Program (FLAP) estimates that in North America at least 100 million birds, mostly low-flying songbirds, die each year in collisions with man-made structures. Glass windows—baffling to birds both day and night—are the biggest contact killers, while disoriented birds may simply exhaust themselves trying to exit the city maze. Still, about half the birds found by FLAP volunteers survive to be released.





WE'VE LIT UP THE NIGHT AS IF IT WERE AN UNOCCUPIED
COUNTRY, WHEN NOTHING COULD BE FURTHER FROM THE TRUTH

"Let thy glorious light ever shine upon it," beseeched the 1995 dedicatory prayer for the Mormon temple in Bountiful, Utah. Plenty of earthly light bathes the granite structure, its brilliance exaggerated by a long photo exposure.

Fire and countless stars illuminate farmer Yacouba Sawadogo (sitting at right) and companions near his land in Burkina Faso, in West Africa. Such night skies "are mostly confined to less developed places," notes one visitor. For all the benefits of artificial light, "we shouldn't pretend that nothing is lost."

shore

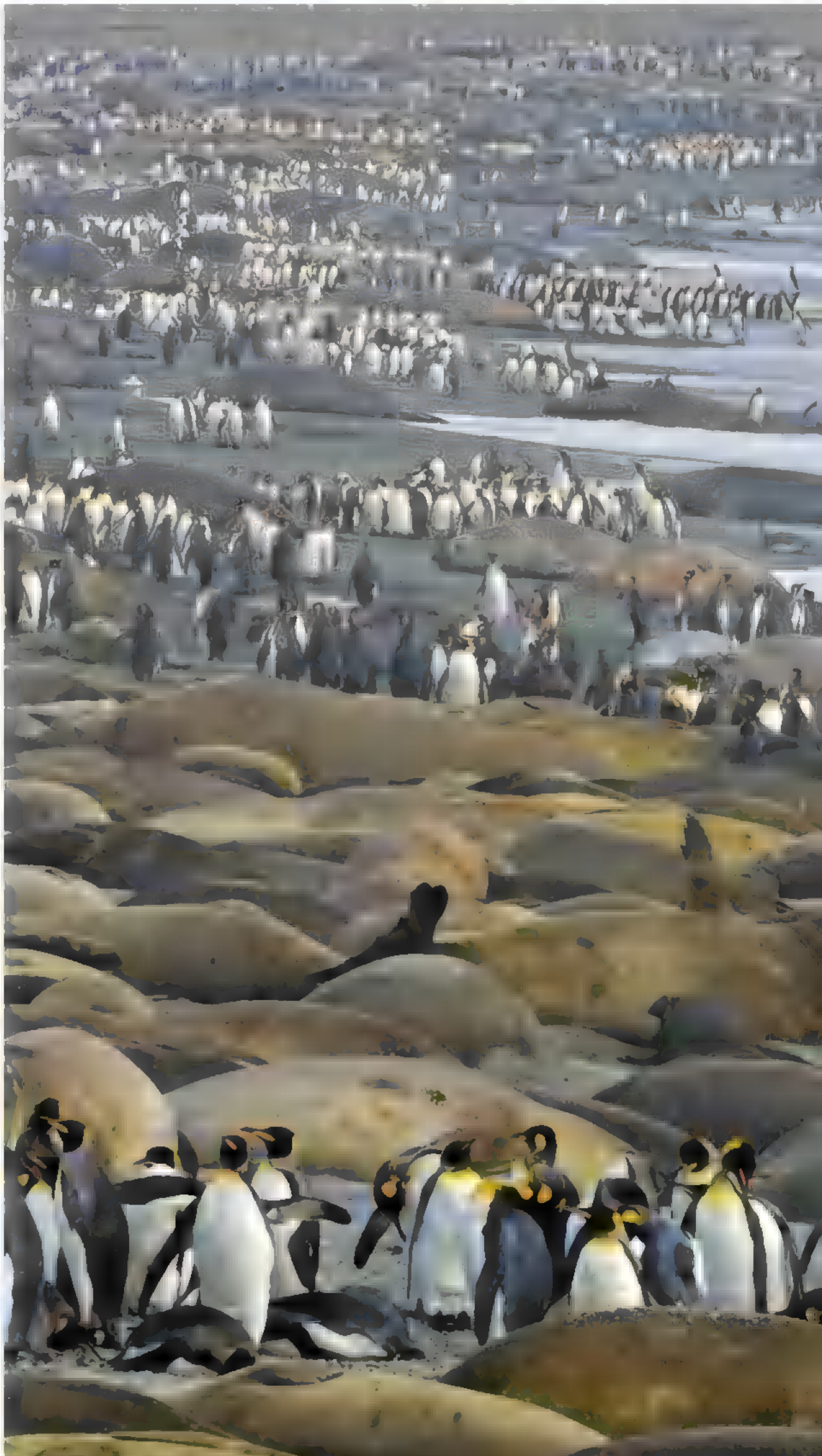
A ROUGH AND RANDY MATING SEASON

leave

ON THE ELEPHANT SEALS OF SOUTH GEORGIA ISLAND

PHOTOGRAPHS BY
YVA MOMATIUK AND
JOHN EASTCOTT

Fattened and then abandoned by mothers who leave to mate anew,
weaned pups stick close together until ready for a first season at sea.



King penguins skirt dense harems of southern elephant seal cows herded by dominant males. Some 400,000 seals line South Georgia Island beaches in Antarctic spring, congregating to birth pups and conceive new ones.

A gory duel for dominance erupts between battle-scarred masters of two harems. Sinking teeth into thick skin, the attacker sends his opponent rearing eight feet high (left). Not badly hurt, the enraged rival fights back and sends the other male scurrying (top). His corner of the beach secure, the triumphant bull advances, bellowing (above), toward his harem, where he'll seize the first available female and mate.

BY SUSAN CASEY

When it comes to ocean predators, it's easy to underestimate the southern elephant seal. It doesn't have the lordly bearing of the sperm whale or the fighter-jet sleekness of the white shark or the stellar IQ of the orca. Unlike the giant squid or the leopard seal, it lacks an aura of mystery and menace. And who came up with its physique—Dr. Seuss? That would explain the nose, a preposterous trunk that can grow one-and-a-half feet long, earning the elephant seal its name. To judge by appearance, this is one misfit beast. Car-size and blimp-shaped, on land the southern elephant seal *(Mirounga leonina)* is usually found lolling around on the beach. But as with other sea creatures, the truth lies below the surface. Sure, it's no supermodel, but underneath the blubbery disguise the elephant seal turns out to be a superhero, its life a series of magnificent feats.

To see where the action takes place, run your finger down a map of South America until you hit Tierra del Fuego and then veer sharply east. Nine hundred miles past the Falklands you'll find South Georgia Island, a hundred-mile-long silhouette of jagged, ice-capped peaks that juts out of what some call the Southern Ocean, the vast belt of water surrounding Antarctica. It's a harsh destination for humans, accessible only by a white-knuckle boat trip that can last five days in South Atlantic gales. But for the seals, which spend 80 percent of their time hunting in these waters, South Georgia is an ideal gathering spot. Come mating season, some 400,000 southern elephant seals will line its shores.

The congregation begins in mid-September, when the first bulls arrive, hauling out on the stony beaches and, almost immediately, starting to fight. These are not minor tussles. They can be bloody battles during which noses are ripped, skin is flayed, and eyeballs end up on the ground. Stakes are high: Only a third of these males will win the chance to breed, a small number considering that they're all loaded with testosterone and equally driven to pass on their genes. Size is definitely a factor here. Bulls can tip the scales at four tons, the weight of a large SUV, and the most colossal males tend to dominate. These turf wars also feature much displaying with that improbable nose, including bellowing with it, puffing it out, and, in general, showing it off.

Scientists refer to the triumphant males as beachmasters—each will control a harem that can range in size from 20 females on the low end to larger conclaves of 300, and in extreme cases, to supersize harems of more than 1,000. When the females arrive in early October and settle down—first to have their pups, then to suckle them, and then, about three weeks after they've given birth, to mate again—part of the beachmaster's job is to protect his females from the unwanted attentions of marauding males. In larger harems a few runners-up find their place around the fringe, but the vast number of vanquished males are left on the sidelines, frustrated and still aggressive. This means more fighting.

"It's definitely not Disneyland out there," says Mike Fedak, a biologist with the U.K.'s National Environment Research Council Sea Mammal Group. "There are significant risks to this whole harem business." This is true not only for seals, but also for humans. As scientists move among the harems, they're careful not to get caught

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Susan Casey is the author of The Devil's Teeth, *about great white sharks. Yva Momatiuk and John Eastcott photographed the wolves of Denali for their most recent feature in the magazine.*

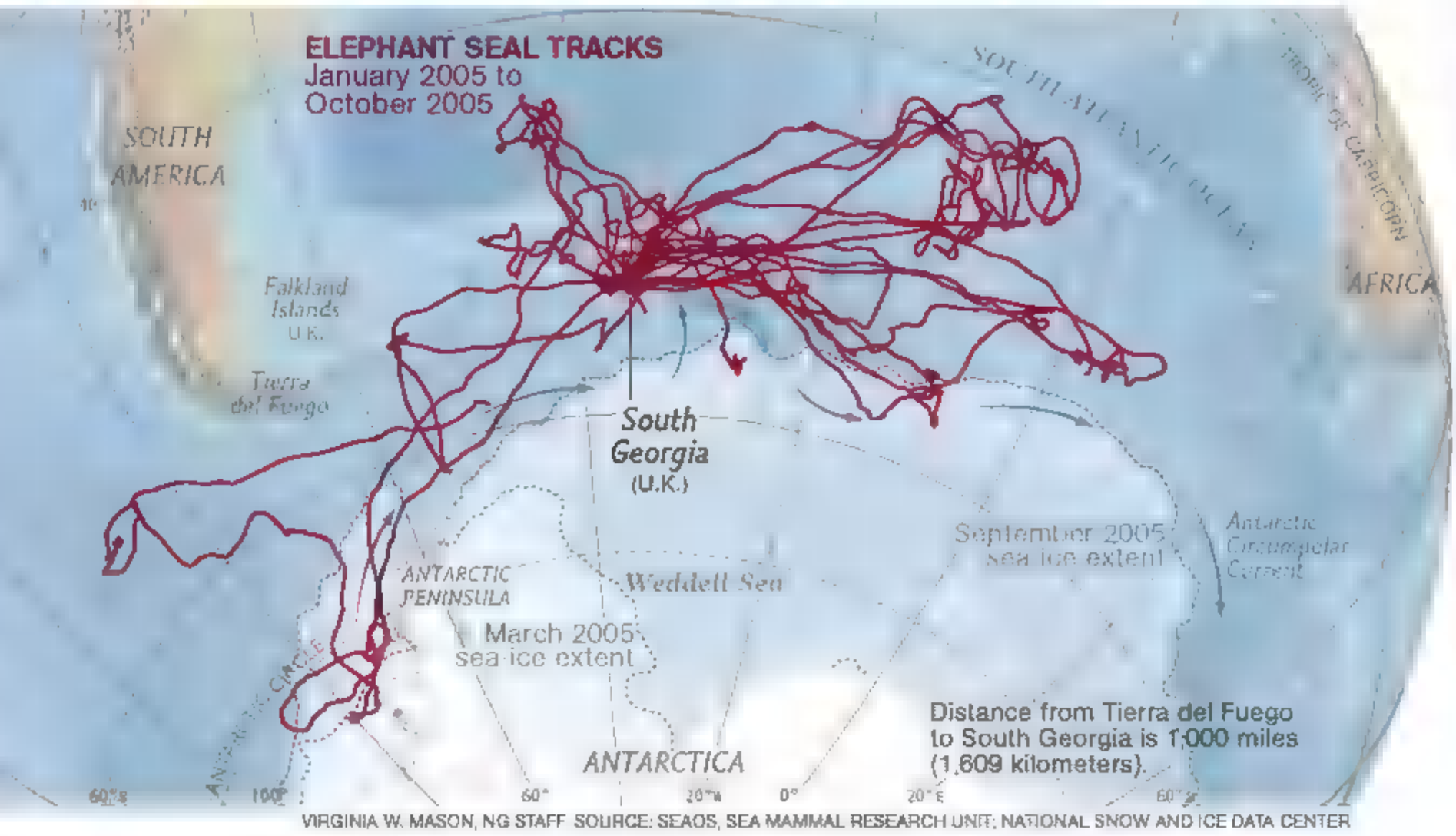
between a beachmaster and his rivals. "You really have to watch yourself," Fedak says. "They can move with amazing agility for animals with no arms or legs."

By late November the party is winding down and the adult seals, which haven't eaten during this time, have lost up to half their body weight. The pups, meanwhile, have gained about ten pounds a day during the three weeks they've fed on their mothers' rich milk. As a female prepares to return to sea, she mates, then weans her pup abruptly, leaving it to its own devices. And then she's gone, pregnant with the pup that she'll deliver next year on these same shores.

Soon the males and the pups will follow her into the water—and this is where the elephant seal reveals itself to be one of the most perfectly adapted predators on Earth. While offshore the seals make journeys of more than 8,000 miles and dive as deep as 5,000 feet, beyond the range of most submarines. For months they hunt for squid and fish, searching for where currents deliver the most nutrients, which in turn attract the rest of the food chain. They can remain submerged for as long as two hours and need only a few minutes of surface time to recover. All this is made possible by some nifty physiological tricks that include shutting off parts of their metabolism to conserve oxygen. Elephant seals are packed with oxygen-rich blood—20 percent of their bodies by volume, almost three times as much as humans.

Given the difficulties of studying a creature that can be found a mile beneath Antarctic sea ice, scientists have recently begun to affix satellite tags to the seals. Along with tracking the animals' movements, the tags deliver an added benefit: They're helping oceanographers figure out the effects of climate change. "There's a real worry right now that ocean-circulation patterns might be changing," Fedak says, describing a scenario that would have massive repercussions for the Earth's weather. "The Southern Ocean plays a critical role in this, and yet it's one of the most data-poor areas. These animals are able to take the devices into places that are unsampled otherwise." Information about water temperature, salinity, and currents in some of the Southern Ocean's least accessible areas is now pouring into the five-year-old Southern Elephant Seals as Oceanographic Samplers program.

So never mind the wacky nose and ungainly body. Gliding beneath a blue icescape, the southern elephant seal is not just going about its business. Like any self-respecting superhero, it's helping save the planet.



Offshore odysseys consume up to 80 percent of an elephant seal's life. Satellite tracking of 13 South Georgia Island seals traced average feeding journeys of 8,000 miles (left) to prepare them for months of fasting while on shore.

VIRGINIA W. MASON, NG STAFF. SOURCE: SEAOS, SEA MAMMAL RESEARCH UNIT; NATIONAL SNOW AND ICE DATA CENTER

What looks like a kiss from an elephantine snout (left) is likely a bite to ensure a female does not elude an avid male. At up to 8,800 pounds, adult males can be ten times more massive than females. After an 11-month gestation, a pup emerges onto the sand with tongue out (top). Mother and pup nuzzle (above) to learn each other's smell. Before weaning at about three weeks, the 90-pound newborn could triple its weight, while the nursing mother may lose a third.

Outside looking in,
a lone male lurks at
the edge of a harem.
Another year of
feeding at sea may
give him the bulk and
the strength to win
his own domain. □

Like curtains drawn across the landscape, the walls of the Toad River Valley yield to untracked forests and pure lakes in northeastern British Columbia. Years of compromise and careful planning defined the

Northern Giant

THE LARGEST WILDERNESS REGION IN THE CANADIAN ROCKIES MIGHT NEVER HAVE BEEN PRESERVED IF NOT FOR A FORMER LOGGER WHO CAME TO THE RESCUE.

enormous Muskwa-Kechika Management Area here, where competing interests—from miners to outfitters, preservationists, and native peoples—coexist in delicate balance.

"You have to know what you're doing out here," says Wayne Sawchuk, leading horses over a nameless stream during a month-long trek through the Muskwa-Kechika, or M-K. Sawchuk, ■ logger turned

conservationist, was key in negotiating the settlements that patched the M-K together. “The challenging part was getting all those parties to agree. But in the end everyone realized it needed to be saved.”

BY JOHN VAILLANT

PHOTOGRAPHS BY MICHAEL CHRISTOPHER BROWN

The route over Misery Pass

is invisible unless you know exactly what to look for. There are no roads here at the headwaters of the Gataga River in British Columbia's northern Rockies, only animal trails, and that's the way Wayne Sawchuk likes it. "There should be one place in the world where you have to find your own trail," he says. "All it takes is a little guts."

The shale beneath our feet is slick with rain and offers about as much traction as a pile of broken china. It shatters under the weight of the horses' hooves as they slip and grind, sending shards clattering into the gorge. A thousand feet below is the tree line, and a thousand feet above is the pass, threading its way between a pair of hulking 9,000-footers. In every direction glaciers loom, strangely luminous beneath a heavy gray sky.

There are six of us and thirteen horses. But no one is riding because the trail is simply too steep—at times pushing 50 degrees. We lead our mounts by their reins knowing that if one of them loses its footing there is no way we'll be able to stop it from tumbling into the boulder-filled cataract that plummets headlong to the valley floor. But it's either get over the pass or take a hundred-mile detour.

Two weeks earlier, Sawchuk nearly lost Leo, a young packhorse, while crossing a river near here. It wasn't the current that almost took the horse under; it was the glacial cold. It took five people—who nearly froze themselves as well—to man-haul the horse up the riverbank, and half an hour to thaw him out (and that was in July).

Biologist Liz Williams thanks her favorite horse, Percy, during a rest stop on the trail. The M-K's wilderness supports elk, bears, sheep, wolves, and other large mammals—a diversity rarely found elsewhere in North America. One reason: Few roads slice through this country.

It's a common hazard in this country, where you can make a dozen river crossings a day.

By the time we reach the saddle of Misery Pass, it is hard to tell who's blowing harder, the humans or the horses. We catch our breath in a wind-scoured trough dotted with shallow blue tarns and little else. The season's last lupines and moss campions are putting on a brave display. Symmetrical depressions in the lichen-speckled scree look like graves, but they're not; they're sheep beds, and they could be a thousand years old. Midway across the pass we come upon the first significant evidence of human presence we've seen in days: a plane crash. Nothing is left from the belongings of the occupants now but four pairs of sneakers, each shoe still neatly tied. "That plane didn't leave a mark on the rock," Sawchuk murmurs, his words practically sucked from his mouth by the wind. "The mountain is implacable."

This is the Rocky Mountain divide, two

John Vaillant is the author of The Golden Spruce: A True Story of Myth, Madness, and Greed. *This is Michael Christopher Brown's first story in the magazine.*

degrees south of the 60th parallel and, just like the people in that plane, all we want to do is get across. We don't know yet that the way down is almost as steep, which means we'll still have to lead our thousand-pound horses, only this time they'll roll right over us if their hooves fail to hold. This, I realize, is the price of admission into Sawchuk's world.

Whipcord thin, with fingers that seem to have the consistency of cold chisels, Sawchuk has been exploring this country for more than 20 years, winter and summer, and, like few others alive, knows what it takes to survive here. On the left side of his saddle he carries a cruising ax in a scabbard. Slung off the right side is a lever-action Browning .308 (no one, it seems, travels in here unarmed). A small chain saw rides atop one of the packhorses. Sawchuk carries a set of farrier's tools, two full sets of rain gear, spare horseshoes in four sizes, duct tape, copper rivets, buckles and leather for harness repair, and a miniature anvil.

Skilled at a startling variety of things, he's a hard guy to peg. In addition to being a trapper, guide, former big game hunter and logger, he's also an author, photographer, and amateur paleontologist who has made significant fossil discoveries in the region. In the space of a few sentences Sawchuk can say "goll-durned" with a straight face, compare a rock formation with the ruins at Thebes, and then define and spell "solifluction" (water-soaked ground flowing downhill under its own weight).

Sawchuk was born and raised in country like this. Though this wilderness has nearly killed him on several occasions, it has also kept him alive—not just in body, but in soul. "I may have pissed away my twenties and part of my thirties," he says of the rowdy, hell-bent years he spent logging, partying, and grizzly hunting

Logs rib the main yard at the PolarBoard mill near Fort Nelson. Logging is permitted in some parts of the M-K, though only minimal harvesting has taken place so far. The U.S. housing slump has forced this mill to shut down indefinitely.

in B.C.'s mountainous interior, "but now I've atoned for some of that."

Sawchuk's atonement, if it can be called that, is on such a massive scale it makes one wonder at the sins that inspired it. Since 1993 he has worked as a conservationist funded by private donors, and most of his energy, paid and volunteered, has been concentrated on the vast mixed-use landscape called the Muskwa-Kechika Management Area that we are now taking a month to cross. If you've never heard of it, it's no surprise; few British Columbians have either. Named for two of the region's biggest rivers, the Muskwa-Kechika, or M-K, is arguably the biggest well-kept secret in North America.

Stretching southeastward from the Yukon-B.C. border, the M-K enfolds Canada's northern Rockies in a 16-million-acre (25,000-square-mile) embrace. Encompassing mountains, meadows, rivers, and forests, its sprawling wilderness represents the largest intact wildlife habitat in the entire Rocky Mountain chain. Seven times the size of Yellowstone National Park, and only slightly smaller than the state of Maine, the M-K contains 50 undeveloped watersheds and the greatest combined abundance and diversity of large wild mammals in North America. Species include grizzly and black bear, wolf, lynx, caribou, elk, moose, bison, two kinds of deer, and most of the continent's population of Stone sheep. The region has been called North America's Serengeti; the sheer size, complexity, and intactness of the place make it unique on the continent. And the M-K might never have come into existence if it weren't for Wayne Sawchuk and a band of visionary conservationists and biologists who took advantage of an extraordinary confluence of events.

In the early 1990s the B.C. government was under pressure to decide, once and for all, how to manage the vast resources of the province. Sawchuk and others recognized the conservation opportunity of a lifetime. Although he was still a logger at the time, he teamed up with George Smith, then national conservation director for the Canadian Parks and Wilderness Society, to launch the Northern Rockies–Totally Wild campaign. They were joined by an unlikely group of fur trappers, guide outfitters, and biologists, all of whom understood a basic principle of conservation biology—that the best way to protect an ecosystem is to keep it intact.

Harvey Locke, founding father of the Yellowstone to Yukon Conservation Initiative (of which the M-K is a key link) makes no bones about Sawchuk's contribution to the M-K: "He wasn't the only guy, but boy oh boy—without him, I don't know if it would have happened." While George Smith handled political strategy, Sawchuk and his former partner, Marce Fofonoff, guided people from the media, government, and scientific communities through northern B.C.'s vast country on horseback, so they could see firsthand what was at stake. Smith, Sawchuk, and others also engaged in a series of grueling negotiations over the M-K, initiated by the provincial government, that lasted nearly ten years. At the table were guide outfitters, recreational

ALASKA HIGHWAY
60° N
Watson Lake
Lower Post
YUKON
BRITISH COLUMBIA
N.W.T.
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
Fireside
Gas wells
Table Mountain
ROCKY
Special Management Zone
Commercial recreation is emphasized; temporary roads are permitted for industrial development.
Enhanced Resource Development Zone
Concentrated along the Highway 97 corridor, this least restricted zone allows most industrial development.
Fort Nelson
Muncho Lake
Toad River
MUSKWA RANGES
Wokkpash Gorge
Protected Areas
All industrial development is prohibited.
Mt. Roosevelt
9,236 ft
2,815 m
Author's route
Kutcho Creek (planned)
Gataga Pass
Misery Pass
Special Wildland Zone
Conservation and backcountry recreation is stressed; logging is prohibited, but temporary roads are allowed for oil and gas and mineral exploration.
Fox and Obo Special Management Zones
Permanent roads are allowed for logging.
MUSKWA-KECHIKA MANAGEMENT AREA
Trutch
ALASKA HIGHWAY
Ft. Ware
Akie (planned)
Shasta
Kemess
MOUNTAINS
Sustut (planned)
Aley (planned)
PINE LE MORAY PROVINCIAL PARK
27
ALASKA (U.S.)
YUKON
NORTHWEST TERRITORIES
Whitehorse
Juneau
Muskwa-Kechika Management Area
ROCKY MOUNTAINS
Chetwynd
Alberta oil sands
BRITISH COLUMBIA
ALBERTA
JASPER N.P.
Edmonton
Yellowstone to Yukon Conservation Initiative region
BANFF N.P.
Calgary
Vancouver
CANADA
UNITED STATES
MONTANA
PACIFIC OCEAN
WASHINGTON
Helena
YELLOWSTONE NATIONAL PARK
OREGON
Boise
IDAHO
WYOMING
0 mi 200
0 km 200
Mine
0 mi 25
0 km 25

Working Wilderness

The 16-million-acre M-K sprawls across one of Canada's richest regions. Significant deposits of gold, copper, and natural gas tapped at mines and wells outside the M-K likely extend beneath it. To satisfy all the voices clamoring for access to—or preservation of—the area, planners devised a unique patchwork of management zones (above). In the most highly protected, mining and forestry are not allowed. In other areas, resource extraction is permitted to varying degrees—all of it governed by strict environmental regulations. The M-K also represents a major link in a 2,000-mile-long wildlife corridor from the Yukon Territory to Yellowstone National Park.

MARTIN GAMACHE, NG STAFF

SOURCES: RICK TINGEY, ROUND RIVER CONSERVATION STUDIES; JENNIFER BROOKS, INTEGRATED LAND MANAGEMENT BUREAU; BRITISH COLUMBIA LAND AND RESOURCE DATA WAREHOUSE; YELLOWSTONE TO YUKON CONSERVATION INITIATIVE

Stories told by a snapping fire, the glint of tack hung to dry, the yawning silence of the night sky—for many visitors to the M-K, these experiences evoke a vanished world. Journeys here can be hazardous,

rescue uncertain. Vast distances mean travelers must often resupply by floatplane. Even trails are hard to come by: Planners hope to preserve the raw aesthetic by keeping most trails unmarked.

Relief is a rolling back scratch in the brush for a hobbled horse freed of its saddle. Several outfitters guide clients into the M-K, and some take hunters, who pay thousands of dollars for a shot at big game. At a remote camp, wrangler David McAleney gears up for a trail ride.

hunters, representatives from the oil and gas, mining, and timber industries, snowmobilers, environmentalists, local businesspeople, government officials, and others who had a stake in the region. (Some First Nations groups elected not to participate fully, fearing it would compromise ongoing treaty negotiations.)

"We argued over every last foot," Sawchuk recalls. But they all had a powerful motive. "If we couldn't come to an agreement, the government would decide for us, and that scared the hell out of everybody."

The formula they helped hammer out called for 25 percent of the M-K to become provincial parks; 60 percent have been designated "special management zones" that are open to oil, gas, and mineral development, but (in theory) only on a limited basis. Most of the remaining 15 percent are "special wildland zones," where logging is prohibited. Officially legislated in 1998, the creation of the M-K was as much as anything a colossal act of faith—an invitation to a wide variety of stakeholders to rise to the occasion of one of the last best places on Earth and to do their best to keep it that way. Too big and too valuable to simply lock up, the M-K embodies an inspired attempt to find a kind of middle way to meet the needs of an ecosystem, its peoples, and the wider public all at once.

Sawchuk's journey to become a self-styled guardian and ambassador was a circuitous one, and along the way he saw and did things that still haunt him.

The Peace River region southeast of the M-K, where he lives, is a broken patchwork of farmland and clear-cuts tightly crosshatched by seismic lines and access roads for natural gas wells. The Peace River itself has been dammed not once but twice, and a third dam is being considered. But it wasn't always that way. "When I was growing up, we were on the frontier," he says. "To walk to my grandmother's house, I had to travel through wild country." During his lifetime, logging, mining, and gas exploration have made the country virtually unrecognizable. "It could happen here, and it wouldn't take long," he says of the M-K.

When he was 11 years old, Sawchuk remembers gathering as many fallen cherries as he could carry from an orchard. It sounds like an idyllic image until you understand that the entire orchard had been felled by a chain saw. The faller was Sawchuk's father.

In the late 1960s, British Columbia was

aggressively tapping its hydroelectric potential, and Sawchuk's father, Mike, a Seventh-day Adventist with a work ethic Noah would have admired, had a contract to dismantle one of the towns that would be flooded by the Keenleyside (Arrow Lakes) Dam. The job took weeks to complete, so the whole family relocated to the doomed town of Burton.

On weekends young Wayne helped his father with the demolition, and during the week he went to school with the same children whose homes, barns, and orchards his father was bulldozing into heaps. At night those towering piles would be set ablaze. "The fires of those burning houses would light up the whole valley like it was day," Sawchuk recalls. "I remember the kids at school looking at me like I was some kind of devil. I saw their faces through the window in the school bus: They looked like war children—like refugees."

Today that lost world lies at the bottom of one of the largest man-made lakes in North America. "It just makes you cry," Sawchuk says, "when you think of all the places that went under." And yet, at the time, few people questioned it, and they certainly didn't question the jobs that put food on the table.

As soon as he was old enough, Sawchuk went to work as a logger alongside his father and brothers. But as he saw the forest denuded by chain saws and log skidders, Sawchuk began to question the ethic he had inherited from his father. Doubt metastasized into torment. "It became harder and harder for me to get back on that skidder," he says. "There were mornings I would throw up before going to work."

The final straw came in 1990, when one of the last untouched watersheds around his hometown was slated to be logged. Sawchuk committed what in the eyes of some was an act of treason. Still working as a skidder operator, he started a campaign to protect the Mountain

Cut by wind and water, hoodoos stand guard above glacial Wokkpash Creek. Remoteness shields the M-K. Buried wealth—especially in natural gas—may be great, but few have invested the cash to exploit

it, says Richard Neufeld, British Columbia's minister of energy, mines, and petroleum. "I don't think there will be a lot of development in the near term. At least while there's gas that's easier to get to."

Creek Valley. He became a charismatic speaker and, with the aid of a compelling slide show, he rallied many to his cause. That contested valley is now a source of local pride: the 100,000-acre Pine Le Moray Provincial Park.

On the day before we cross the divide, we hike up to a place where Sawchuk has never been—which is saying something. Sawchuk has spent years exploring the region on foot, horse, snowmobile, and snowshoes, but he'd never made it up to Gataga Pass. Then again, few people have. A handful of hardy local hunters, hunting guides with well-heeled clients, and helicopter-borne mineral prospectors are about the only visitors to these glacier-bound peaks. The view, once you get there, is on an IMAX or Grand Canyon scale. From the 6,000-foot saddle where we stand, the mountain falls away for thousands of feet into a lush, green valley that stretches southward for 15 miles before running into yet another phalanx of glacier-clad mountains.

It's breathtaking, not just for its beauty, but for its sheer size; this enormous valley seems to have its own gravitational pull. All around us, the rush and roar of rivers being born thrums in our ears as glacier-fed waterfalls carve near-vertical paths down the mountainsides. Far below, the scars of winter's avalanches appear as great swaths of flattened trees. A moose cow and calf graze at the tree line while, high above, a dozen mountain goats trail across a precipitous scree slope, challenging the stability of its angle of repose.

What is so extraordinary about this wilderness is that one can follow these rivers and explore these ranges for days and weeks and never see a person, a rail line, or even a fire tower. This is the West as Lewis and Clark, or Roosevelt and Muir, might have seen it: a landscape without familiar reference points, where everything is so massive and raw that estimates of height and distance continually fall short of the reality. In the upper Gataga Valley we crossed a recent rockslide that could have buried a football stadium. In the upper Tetsa there are anonymous waterfalls with drops approaching a thousand feet.

The animals behave differently in here too, and it underscores a key distinction between

It began as a radical experiment in land-use planning, and ten years on, the M-K seems a success. But Wayne Sawchuk (on lead horse) knows the years of toil could unravel rapidly. "There's no guarantee the protection will remain in place," he says. "It's going to take a lot of care to keep this going."

places like national parks, where wild animals live but are habituated to human beings, garbage, and cars, and places like the M-K, where they are truly wild. Despite the fact that we encountered grizzly signs every day, including numerous kill sites, we never secured our food. To a seasoned outdoorsperson such behavior might seem irresponsible or even dangerous, but here humans are alien, to be avoided, and bears stayed away from our campsites. Only the mountain caribou (which travel in far smaller groups than their barren-ground cousins) were overcome by curiosity, and sometimes they would shadow us on the trail.

In all these ways, the M-K makes it easy to forget what century you're in. "For years we traveled with no communication of any kind," Sawchuk says, recalling his early forays through this country. "The outside world could be blown up and you'd never know."

To see what might have happened here if

Sawchuk and others hadn't intervened, you don't have to go far. Immediately to the west, enormous open-pit copper, lead, and zinc mines are already up and running, and as of this writing, tens of millions of dollars are being invested in even more ambitious projects. To the east, beyond thousands of square miles of natural gas wells, lie the Alberta oil sands, a monumentally expensive and environmentally destructive oil-extraction project. Nor is the M-K immune. Because of its somewhat vague "special management" status, many individuals close to the M-K believe the future of this grand experiment is precarious at best. "What we've seen over the past few years is an unraveling of the M-K," says Dave Porter, a member of the Kaska Dena First Nation and former M-K advisory board member who has also represented the B.C. Oil and Gas Commission.

Under British Columbia's pro-industry Liberal government, the board's budget for outreach and education about the M-K and what's permitted inside the reserve has been whittled down since 2001 by a third. Conservationists also worry about potential new oil and gas development. Sawchuk is an optimist at heart, but he has no illusions. "We live in a political world," he says. "I wish it was all tied up with a big red bow, but we are going to have to keep defending it. That's just the way it is."

It is in situations like this where the hard lessons Sawchuk learned from his father in the woods around their home become most valuable. "Getting on that skidder every day—even when I hated it—taught me perseverance," he says. And his youthful fight to save his hometown's forest? "That woke me up to the fact that none of these guys are going to stop until you make them stop." □

Society Grant This expedition was funded in part by your Society membership.

A development in Portal, Arizona, features houses equipped with telescope domes.

DARKEST NIGHTS

These spots offer excellent conditions for stargazing.

- ★ Death Valley National Park, California and Nevada
- ★ Natural Bridges National Monument, Utah
- ★ Cherry Springs State Park, Pennsylvania
- ★ Acadia National Park, Maine

Star Chasing Starry nights have become rare and exotic skyscapes for many Americans. Light pollution from major cities extends some 150 miles around the population centers, creating a patchwork of bright spots across much of the country. Star visibility is improved by clean, dry air and viewing from high elevations. To find out how well your sky fares, count the stars in Orion on ■ clear and moonless night—a method professional astronomers recommend to estimate sky brightness. Above major cities, the constellation shows about 11 stars. But far enough away from light pollution, at least 50 should be visible. If counting becomes tedious, the International Dark-Sky Association *(darksky.org)* provides a dark-sky locator to help stargazers find their way into the dark. *—Tammie R. Smith*

PHOTO: JIM RICHARDSON

Jeff Tarrant

Pat Minnick included National Geographic in her financial plans.

Give An Inspiring Gift

In 2007 Pat Minnick, a professional artist, decided to establish a charitable gift annuity to support National Geographic. She now receives a guaranteed life income and is a direct part of the Society's efforts to inspire people to care about the planet.

"I feel good knowing that National Geographic is doing so much to protect endangered wildlife," says Pat. "The environmental problems we face are vast, but by joining with National Geographic and their history of remarkable accomplishments, I know we can pass on a more beautiful world."

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Robb Kendrick shows Tarahumara children *National Geographic.*

ON ASSIGNMENT **Village Portraits** Mexico's Tarahumara people don't like to be photographed while picking corn or doing other daily chores. "They get very self-conscious," says Robb Kendrick, who covered them for this issue. So he decided to focus on portraits. In each village he first talked to community leaders about his assignment and asked them to pose. "If you can get the governor or mayor to agree, then other people kind of fall in line."

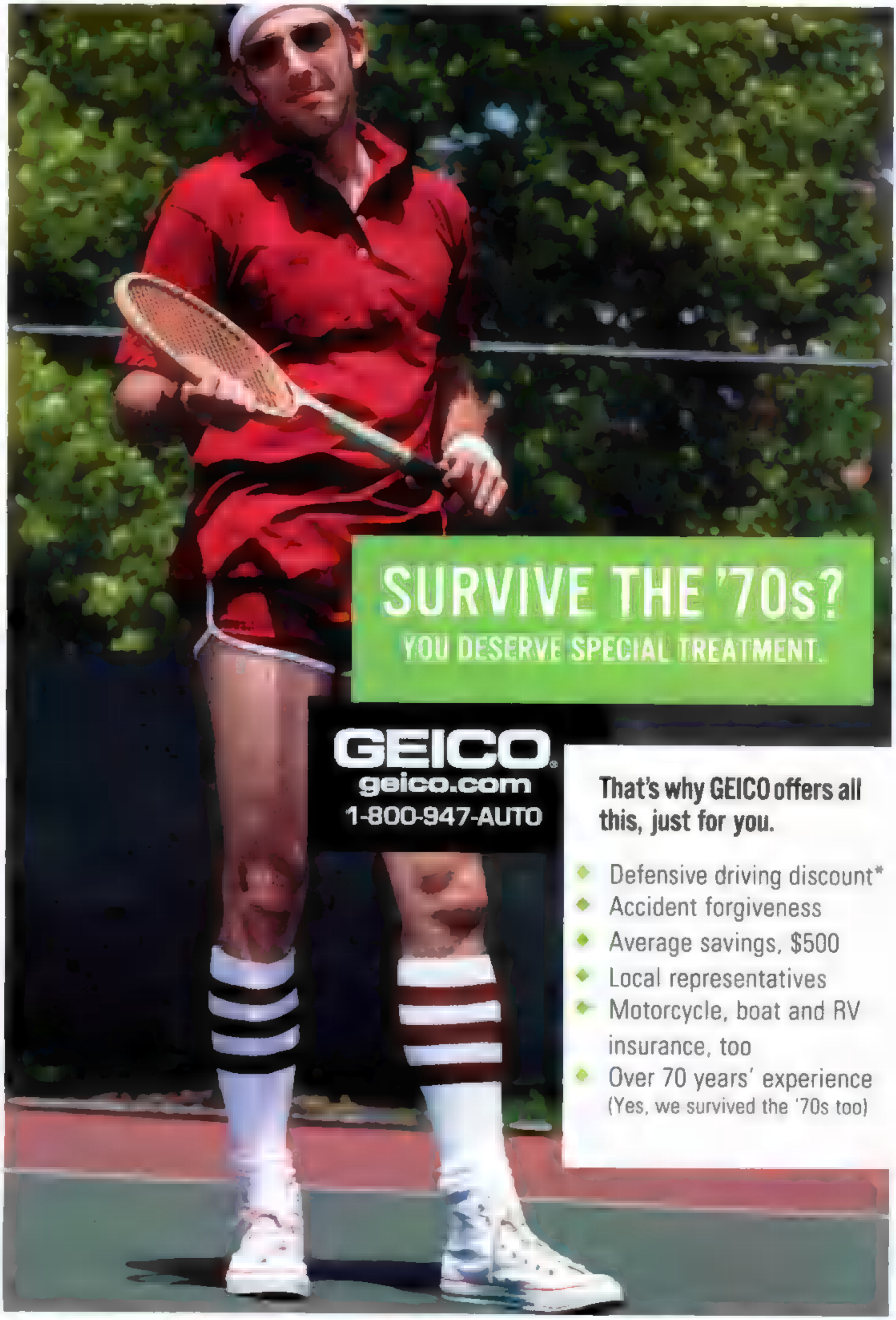
Mattias Klum says this forest fire may have started when someone was trying to clear land for farming: "a slash-and-burn that just got away."

ON ASSIGNMENT

Borneo Watcher

"Borneo is being shopped to death," says photographer Mattias Klum. "Westerners often don't think about how our choices affect this place: food and soap made with palm oil, floors and doors made from rain forest wood. But we can make better choices. It's not just up to politicians to effect change." Klum first visited Borneo 20 years ago; he's returned nearly every year since, most recently for this issue's story "Borneo's Moment of Truth." He says, "This place is part of me now."

PHOTOS: HOLLY WILMETH (TOP); LARS-MAGNUS EJDEHOLM



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INSIDE GEOGRAPHIC

Carsten Peter rests (top) alongside Saúl Villasante, part of a Mexican film crew (above) for the documentary *Giant Crystal Cave.*

ON ASSIGNMENT **Crystal Gazing** At 112°F and almost 100 percent humidity, the air in Mexico's Naica Cave of Crystals is not hospitable. Shooting there for this issue was hard on photographer Carsten Peter's equipment—lenses filled with condensation, lights failed to trigger—and on his body. Even with a special ice-cooled suit, he couldn't work for more than 50 minutes at a time. "You are completely worn out" after emerging, he says. But he still loved working among the giant gypsum crystals. "I couldn't get enough." Tough jobs are ordinary for Peter. He specializes in assignments like climbing inside active volcanoes and diving in frigid glacial lakes. "My equipment doesn't have an easy life," he says. *Giant Crystal Cave*, airing at 10 p.m. on November 17 during National Geographic Channel's Expedition Week, follows scientists searching for clues to the cave's origin—and for life inside its crystals.

NATIONAL GEOGRAPHIC CHANNEL

PEOPLE BEHIND THE STORIES

Cynthia Gorney

The trickiest thing about writing "A People Apart," says *Geographic* contributing writer

Gorney, wasn't reaching Mexico's remote Tarahumara Indians. Nor was it getting a guarded people to talk about their way of life. It was avoiding certain biases. "Any outsider," Gorney says, "including me, thinks: These people are better off with modernity held far away. But that's cultural relativism. We have preconceptions about what is and isn't right, for us *and* for others." To tell the full Tarahumara story, she says, "I kept reminding myself how little I understood about this place, these people."

Mel White

The deforestation threatening Borneo's biodiversity has drawn many international conservationists. Yet the lush island's earnest local activists were the ones that White—a frequent contributor

who wrote "Borneo's Moment of Truth"—found inspiring. "Many young people here," he says, "have devoted their lives to reforming government, fighting corruption, and promoting sustainable use of resources. In one town I met locals working hard to get the word out and stop a swamp forest from being drained and cut [for palm oil production]. 'We're looking for any ideas or contributions,' one man said, 'because people here would welcome any kind of hope.'"

PHOTOS: OSCAR NECOECHEA (TOP LEFT); CARSTEN PETER, SPELEORESEARCH & FILMS (BOTTOM LEFT); MIMI CHAKAROVA (TOP); HOPE NORMAN COULTER (BOTTOM)

world beat

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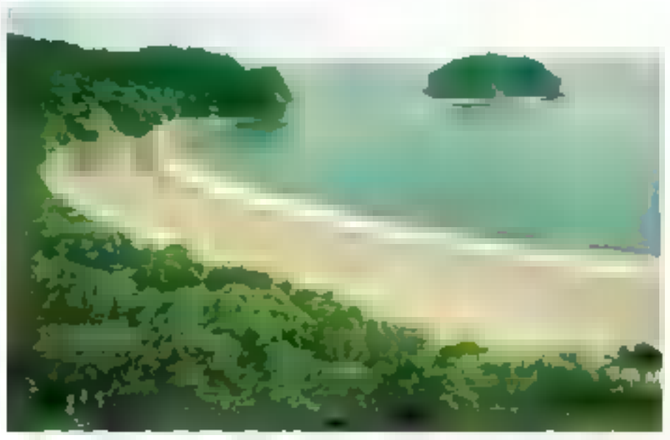

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INSIDE GEOGRAPHIC

Nebraska's Akshay Rajagopal talks to the press after his 2008 bee victory.

20 Years of Bees

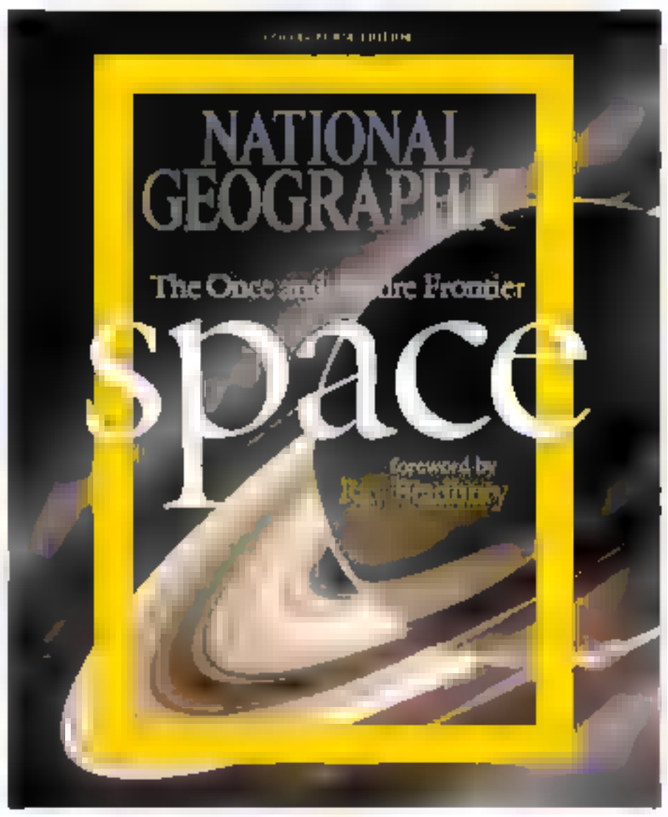
Name the capital of Sichuan, the Chinese province hit by an earthquake in May. Top finishers in 2008's National Geographic Bee knew: It's Chengdu. The questions are new, but some things never change about the 20-year-old event for fourth to eighth graders that brings 55 state and territory finalists to Washington, D.C., every spring. Organizer Mary Lee Elden often hears contestants' parents talk about children who've loved maps since they were babies. Elden points out that bee contestants aren't just memorizing facts. "The kids say they love to read about the world." Learn more about the bee at *nationalgeographic.com/geographybee*.

COLLECTOR'S EDITION

Beyond the Sky

On May 25 of this year the Phoenix lander spread its parachute and drifted down near Mars's north pole—in view of a camera on a nearby NASA orbiter. That picture is part of the grand panoply in *Space: The Once and Future Frontier.*

The special issue covers some 50 years of space exploration, from early astronaut training to the latest space-based telescopes. The universe is presented in new visual ways, including a graphic showing all the manned missions. Science fiction writer Ray Bradbury's foreword talks about his lifelong love of outer space. "I like to think of the cosmos as a theater," he says, "yet a theater cannot exist without an audience to witness and celebrate." You can join that audience. *Space: The Once and Future Frontier* is on newsstands November 1 ($10.99).



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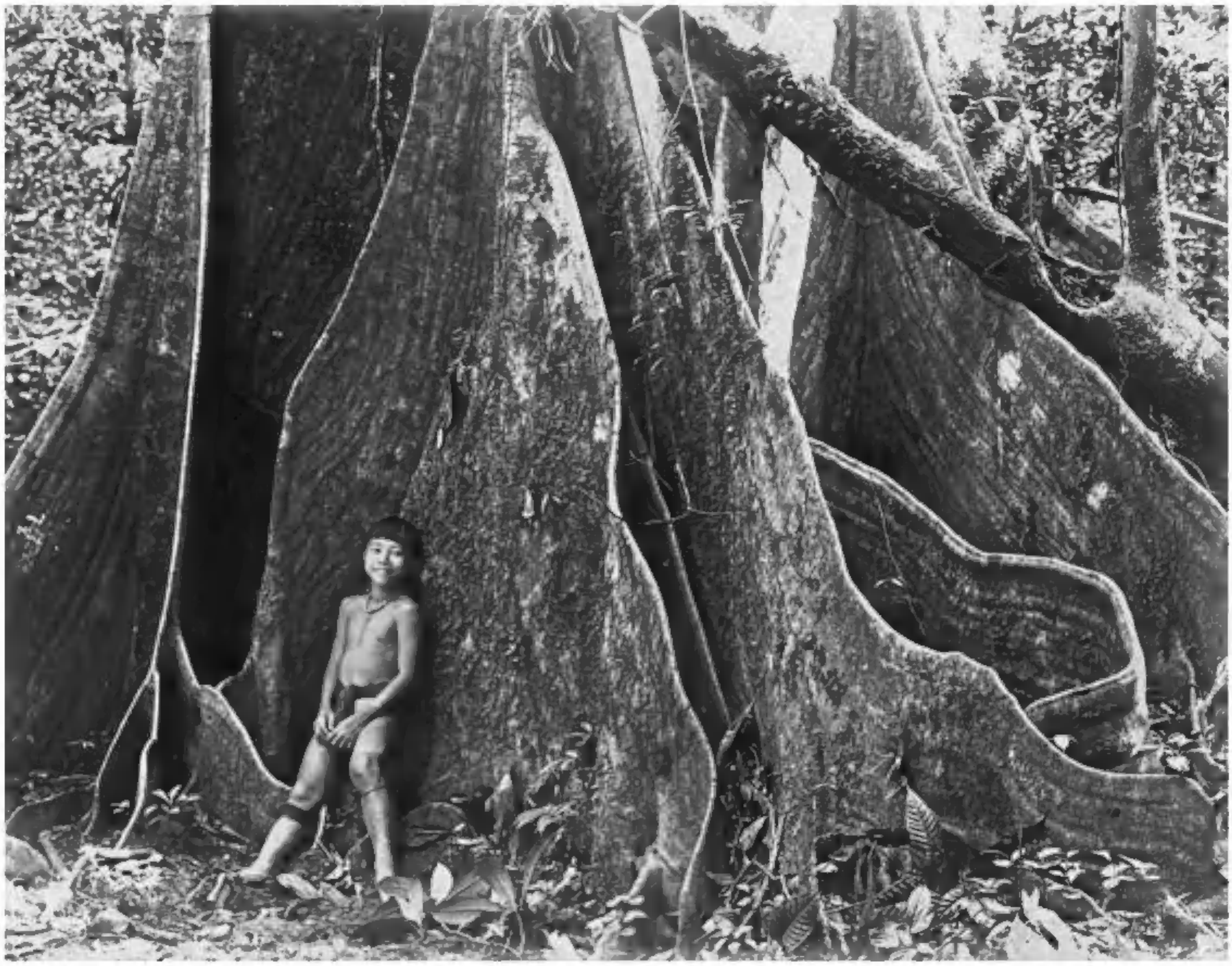
FLASHBACK



A Safe Distance "Indeed, the Sarawak jungle is better protected than our forests," claimed Harrison W. Smith in his February 1919 *Geographic* article, "Sarawak: The Land of the White Rajahs." But, Smith noted, "it was not the natural history of the country" that prompted his visit to Borneo, "rather the opportunity to become acquainted with primitive and interesting people." Though they may not have been so eager to become acquainted with him. "As with most of the Sarawak tribes, personal cleanliness is the rule," he wrote. "The Dayaks have been known to comment on a white traveler to the effect that, although he seemed to be otherwise all right, he did not bathe as frequently as they considered necessary." *—Margaret G. Zackowitz*

Flashback Archive Find all the photos at **ngm.com.**

PHOTO: HARRISON W. SMITH, NATIONAL GEOGRAPHIC STOCK

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